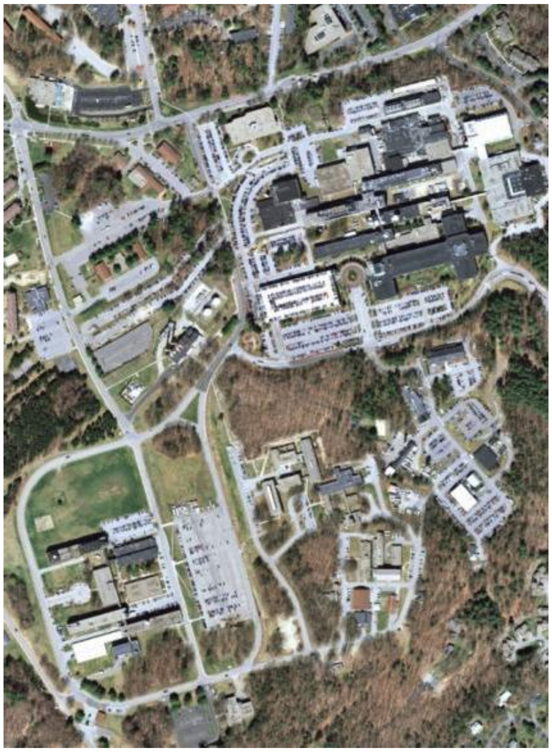
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

FACILITIES REPLACEMENT ON HANSCOM AFB
PHASE 1



FINAL
ENVIRONMENTAL ASSESSMENT

Prepared by:

AECOM

for:

MIT Lincoln Laboratory

Massachusetts Institute of Technology

July 2014

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
24 JUL 2014	**Environmental Assessment**	**00-00-2011 to 00-00-2014**

4. TITLE AND SUBTITLE **Massachusetts Institute of Technology Lincoln Laboratory Facilities Replacement on Hanscom Air Force Base Phase I Final Environmental Assessment**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **United States Air Force,Hanscom Air Force Base,Bedford,MA,01730**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Massachusetts Institute of Technology Lincoln Laboratory Facilities Replacement on Hanscom Air Force Base Phase I Final Environmental Assessment

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**247**	

FINDING OF NO SIGNIFICANT IMPACT
MIT LINCOLN LABORATORY
FACILITIES REPLACEMENT - PHASE 1
HANSCOM AIR FORCE BASE, MASSACHUSETTS

Pursuant to the Council on Environmental Quality regulation for implementing the procedural provisions of the National Environmental Policy Act (NEPA), Title 40 of the Code of Federal Regulations (CFR) §§1500 – 1508; Air Force Environmental Impact Analysis Process regulations 32 CFR §989 and Department of Defense Directive 6050.1, the Massachusetts Institute of Technology, Lincoln Laboratory (MIT LL) in coordination with the Air Force has prepared an Environmental Assessment (EA), titled MIT LL Facilities Replacement on Hanscom Air Force Base (HAFB) Phase 1, to identify and assess the potential impacts on the natural and human environment associated with the redevelopment of the MIT LL facilities. While MIT LL is a Department of Defense (DoD) Federally Funded Research and Development Center (FFRDC), MIT LL is not a federal agency[1] per NEPA (40 CFR § 1508.12). The development of replacement facilities for MIT LL would require HAFB to execute a land lease with MIT since the action is taking place on HAFB property, thus, HAFB is the lead agency for the Proposed Action, from a NEPA perspective.

Purpose and Need for the Proposed Action **(EA § 1.2, pages 2 – 6):** In order to meet mission demands, MIT LL proposes to construct approximately 500,000 sf of new replacement facilities. Due to the distinct nature of the two proposed replacement facilities needed to meet MIT LL's mission (a Compound Semiconductor Laboratory/Microelectronics Integration Facility (CSL/MIF) and an Engineering and Prototyping Facility (EPF)), it was determined the two replacement facilities were not compatible to be located within one building. Based on the alternative sites available, construction of two buildings would require the use of two sites since both buildings would not fit together within any of the proposed alternative sites. The distinct and independent utility of the two replacement facilities, coupled with site logistics and program logistics, suggest these program moves cannot be conducted simultaneously and efficiently without potential impact to ongoing research and development and the mission of MIT LL. Because the construction cannot be accomplished at one time, MIT LL would implement the project in two phases: Phase 1 and Phase 2. The Proposed Action described in this EA comprises the Phase 1 Facilities Replacement, which includes construction of a 145,000 to 175,000 sf replacement facility (depending on the site selected). Phase 2 would include the construction of an approximate 325,000 sf replacement facility. The Phase 1 facility would comprise Class 10, 100, and 1000 clean rooms, with mechanical, electrical and plumbing support rooms and office space. At the earliest, construction is anticipated to begin spring of 2015 and be completed within 2 years. Occupancy of the building is anticipated shortly thereafter.

Replacement facilities are needed to support MIT LL as a state-of-the-art, federally funded research and development center. Since the inception of the MIT LL campus in the early 1950s, numerous renovations have been completed throughout the campus, often constrained by aging building and infrastructure. Continued occupancy in many of the existing buildings require significant investment (even for deferred maintenance), yet with no inherent functional improvements to support state-of-the-art research. The replacement space would allow MIT LL to vacate and then repurpose or demolish some of the existing buildings within the aging MIT LL campus. The project would also allow MIT LL to relocate some functions, which have become highly compressed or fragmented, and would result in a more efficient, purpose-built research and development laboratory space, with a greater square footage of research space per employee. In addition, the proposed replacement facility would also realign the current shortfall of research space per scientist closer to industry standards.

---

[1] As a Federally Funded Research and Development Center (FFRDC), MIT LL is sponsored by a government agency but is not itself a government agency. MIT LL is part of the Massachusetts Institute of Technology (MIT), which is a Massachusetts non-profit educational corporation.

Description of Proposed Action and Alternatives

***No Action Alternative* (EA § 2.2, page 11):** The No Action Alternative was used to establish the baseline from which all other alternatives were compared against to determine the extent the action would have on the environment. Under the No Action Alternative, expenditures would be limited to operating costs and deferred maintenance, with no new facility constructed. The No Action Alternative would continue to negatively impact operations of critical programs due to possible failure of aging systems as well as potentially impact health and safety of building occupants.

***Renovation Alternative* (EA § 2.3, page 11):** MIT LL considered upgrading the existing laboratory space. Despite considerable capital costs, renovation of laboratory space within the existing buildings would still result in spacing constraints that could impede the ability of MIT LL to safely and efficiently execute its mission. As this renovation was not considered to be a viable alternative, it was not evaluated in the EA.

***Additional Alternatives Considered* (EA § 2.6.1, pages 21 – 22):** Eight sites were initially evaluated for possible siting of a replacement facility. Four of the locations were eliminated early from further consideration either due to impacts to existing mission(s), insufficient security space/flexibility and/or incompatibility with projected long term, land used planning. This left four siting locations (Figure 2.6-1, page 20) to be carried forward for additional analysis: Preferred Alternative (C/J Lot), Alternative 2 (J Building), Alternative 3 (Hillside at Gate 3A), and Alternative 4 (AFRL Open Field). The Preferred Alternative (C/J Lot) is currently used as a parking area. Alternative 2 (J Building) is occupied by the existing J Building; the proposed replacement facility would be constructed within the footprint of the existing J Building and its surrounding parking lot. Alternative 3 (Hillside at Gate 3A) is a wooded hillside. Alternative 4 (AFRL Open Field) is an open field.

Environmental Consequences

Based on the analysis in this EA, no significant adverse impacts to environmental resources are anticipated for the Proposed Action. The following summarizes the potential impacts associated with each of the four alternative sites for replacement facility; further details are provided within the EA. The No Action Alternative was determined to have a potential impact on the health and safety of building occupants and a potential adverse impact on the operation of critical programs due to possible failure of aging systems but would not result in any additional short- or long-term impacts to environmental resource areas; therefore, it is not summarized in the following sections.

***Topography, Geology, and Soils* (EA § 4.2, pages 63 – 65):** For Alternative 3 (Hillside at Gate 3A), considerable grading is anticipated to be required to construct a building at this site due to its location on a moderately sloping hillside, and a retaining wall would need to be constructed. Construction activities at the remaining three alternative sites are not anticipated to impact topography, as these locations are relatively level sites that were previously altered. Due to the potential presence of shallow bedrock, some rock drilling may be required at any of four alternative sites. Because there would be large amounts of soil disturbance from construction activities, work will proceed in accordance with HAFB Best Management Practices (BMPs) for stabilizing soils and minimizing erosion. Only under for Alternative 3 (Hillside at Gate 3A) would the soil classification be re-characterized as Urban land.

***Land Use* (EA § 4.3, pages 65 – 68):** Short-term impacts associated with construction at any of the four alternatives would include temporary disruption to adjacent land uses due to elevated noise levels, increased dust, interference with roadway access, and visual effects. Notification of the proposed construction will be provided to FAA, as construction equipment will penetrate the imaginary surface extending at a slope of 100 to 1 for a horizontal distance of 20,000 feet from the nearest runway. The site for the Preferred Alternative (C/J Lot) is currently used as a parking area, which would be displaced by the proposed replacement facility. For Alternative

2 (J Building), prior to the demolition of the existing J Building, the current office and laboratory functions within J Building would need to be relocated to other areas on the MIT LL campus, HAFB, or off base. In addition, the footprint of the proposed replacement facility is larger than the J Building and thus encompasses part of the parking area around J Building. Little/no space would remain within the site to re-establish parking spaces. Alternative 3 (Hillside at Gate 3A) and Alternative 4 (AFRL Open Field) would result in a change in land use to research and development. The land use change would occur with approval from the Facilities Utilization Board (FUB), a board that evaluates requests for real estate, use of existing facilities, interservice support, and construction to ensure compliance with Joint Civil-Military Engineering Board priorities. For Alternative 4 (AFRL Open Field), the footprint of the proposed replacement facility would permanently displace the existing use as an open field.

Water Resources **(EA § 4.4, pages 68 – 71):** There are no surface water features, wetland resources, or floodplains present within the footprint of any of the four alternatives; therefore, it is not anticipated construction activities will directly affect water resources. Because the project involves surface disturbance, all construction activities would be conducted in accordance with BMPs to reduce the amount of particulate matter entering into receiving surface waters from storm water discharges. Since construction will result in the disturbance of greater than one acre at any of the four alternative sites, MIT LL will obtain and comply with the NPDES General Permit for Storm Water Discharges from Construction Activities. Because construction of the replacement facility would have the potential to intersect the groundwater table due to seasonally high groundwater levels throughout the base; the construction contractor will be required to include provisions for dewatering.

HAFB is required to comply with Section 438 of the Energy Independence and Security Act of 2007 in order to protect water resources at federal project sites that exceed 5,000 sf (0.1 acres) (USEPA, 2009). MIT LL's design of the replacement facility will implement storm water structural BMPs to reduce runoff during wet weather events and retain or infiltrate water on-site (or nearby) in accordance with HAFB's drainage requirements. Construction of replacement facilities at Alternative 3 (Hillside at Gate 3A) and Alternative 4 (AFRL Open Field) would result in an increase of approximately 2.3 acres and 2.9 acres, respectively, of impervious surface within the Shawsheen River watershed. The associated increase in impervious surface would require a more extensive storm water management system (than would be required at the remaining alternative sites) to capture and infiltrate the run-off, such that the rate of groundwater recharge post-construction exceeds that which occurs presently at either alternative site.

Biological Resources **(EA § 4.5, pages 71 – 73):** Construction of the replacement facility would require grading and excavation, resulting in the loss of varying amounts of existing vegetation, depending on the site selected. For construction of the proposed building at Alternative 3 (Hillside at Gate 3A), it would be necessary to clear a portion of the wooded hillside, resulting in the loss of approximately 900 trees >4 inches diameter at breast height. MIT LL has developed a mitigation plan to plant trees elsewhere on HAFB to offset this impact; the ultimate location of the tree mitigation would be determined in coordination with HAFB during design if Alternative 3 (Hillside at Gate 3A) is selected. Time of year restrictions may be imposed on tree cutting, such that trees would be cut in the late fall or winter, prior to the spring nesting/breeding period for birds, to ensure no nests or eggs are destroyed, in accordance with the Migratory Bird Treaty Act (MBTA). Construction activities for Alternative 4 (AFRL Open Field) would require grading and excavation that would displace the existing grass field and potentially two trees (depending on final site layout). While there would be some loss of vegetation under this alternative, the removal of vegetation is not subject to the MA Wetlands Protection Act since there are not any wetlands located within the area. Regardless of the alternative selected, once the proposed building is in place, a landscaped buffer will be created around the perimeter of the building, thereby establishing an approximately 55-ft wide green space with grass, shrubs, and small trees around the building and offsetting any vegetation lost during construction.

Although the diversity and abundance of wildlife are limited on base due to habitat fragmentation, the proposed construction may result in short-term impacts to wildlife. Operation of the replacement facilities are not expected to substantially impact wildlife in the area, as these species are present across the base and have adapted to living in close proximity to human activity. There are no known threatened or endangered species present within or

adjacent to the footprints of any of the four alternatives. Coordination with the USFWS and MA NHESP found within Appendix A confirms this finding.

***Cultural Resources* (EA § 4.6, pages 73 – 76):** The MIT LL main campus is not within a designated historic district on HAFB; however, the Massachusetts Historical Commission (MHC) has recently agreed to establish a single combined Air Force Cambridge Research Laboratories (AFCRL) Historic District to encompass the AFRL Katahdin Hill and AFRL Phillips Lab areas of HAFB. Alternative 3 (Hillside at Gate 3A) is partially located and Alternative 4 (AFRL Open Field) is fully located within this historic district. Regardless of the alternative selected, the proposed replacement facility design is anticipated to be a modern style reflecting the state-of-the-art research to be conducted within its walls. It is expected the proposed building would be designed, constructed, and operated without adverse impact to historic resources, regardless of the location of the alternative selected. Alternative 2 (J Building) comprises the demolition of a building, in addition to the construction of a replacement facility. The existing J Building was initially constructed more than 50 years ago (in 1957) and has since undergone numerous additions and renovations; therefore, it does not maintain architectural integrity warranting consideration as a historical building. Its demolition would not represent an impact to historic resources. Alternative 3 (Hillside at Gate 3A) falls within 1 of 11 areas on HAFB identified as having moderate/high sensitivity for the presence of archaeological resources. The Public Archaeology Laboratory (PAL) conducted an intensive archaeological survey to determine the presence/absence of archaeological resources at Alternative 3 (Hillside at Gate 3A) in November 2012. Based on results of the investigation, construction of the proposed replacement facility would have a low potential to impact archaeological resources. In the event cultural artifacts are uncovered during construction, activities will be stopped and appropriate personnel contacted. Construction activities are not anticipated to have an adverse impact on archaeological resources at the remaining alternative sites. The Preferred Alternative (C/J Lot) is not located within a historic district, nor was it identified as having sensitivity for archaeological resources; thus, no impacts to cultural resources are anticipated.

***Air Quality* (EA § 4.7, pages 76 – 81):** Short-term, localized air quality impacts may occur regardless of the alternative selected, as construction would generate fugitive dust. Standard BMPs will be implemented to minimize impacts. Additionally, construction vehicles and some equipment will produce engine emissions, which could temporarily affect air quality. It is anticipated any construction equipment with an engine greater than 50 horsepower will meet Tier 2, Tier 3, or newer (depending on the engine model year) USEPA emissions standards (including standards for volatile organic compounds (VOCs), hydrocarbons, nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM) for non-road diesel engines and equipment. Additionally, equipment and vehicle idling will be limited to minimize impacts.

The proposed replacement facility will need to be heated, cooled, and ventilated; backup power will need to be provided. Each of these activities could represent a new source of (or an increase in) air emissions, thereby adversely impacting air quality. If the new building were to be heated by the HAFB Central Heat Plant (CHP), the impact on air quality would not be meaningfully distinguished from the overall emissions of the CHP. The incremental demand from the replacement facility would not require the CHP to increase output beyond its already permitted emission levels; thus, no adverse impact on air quality would be expected. If the heating is decentralized, the proposed replacement facility is expected to require stand-alone boiler(s) with a heat input rating of approximately 15,600,000 BTU/hour. MIT LL has a Comprehensive Air Plan Approval that addresses the existing combustion sources at the facility; therefore, it is anticipated an application will be filed, or a new application submitted, to obtain Massachusetts Department of Environmental Protection approval for the boilers. It is not expected these units, in conjunction with the existing sources at the facility, will trigger nonattainment or Prevention of Significant Deterioration (PSD) review. Any installed boiler will comply with EPA's National Emission Standards for Hazardous Air Pollutants (HAPs) for Area Sources (40 CFR Part 63, revised February 1, 2013).

The proposed building is anticipated to have two 500 kW standby diesel-powered generators (although MIT LL is evaluating the feasibility of natural gas powered generators). Permitting thresholds for new emergency engines

were established in MA Air Regulations under 310 CMR 7.26 (42); i.e., the Environmental Results Permitting (ERP) Program. If an emergency generator has a rated output of 0.037 MW or greater and is constructed after March 1, 2006; the emergency generator is subject to 310 CMR 7.26(42) and not subject to permit thresholds established in MA Air Pollution Control regulations for Comprehensive Air Plan Approval (310 CMR 7.02(5)). Fuel type is limited to ultra-low sulfur diesel or natural gas and hours of operation are limited to 300 hours per year under 310 CMR 7.26 (42). A permit application will be submitted under the ERP program to obtain approval for only the emergency generator. Any installed emergency generator will comply with EPA's National Emission Standards for Hazardous Air Pollutants (HAPs) for Area Sources (40 CFR Part 63).

Potential emissions of these stationary sources (i.e., boilers and generators) are 9.64 to 10.69 tons/year of NO_x and 0.27 to 0.30 tons/year for VOC. The combination of these stationary sources and estimated construction-related mobile emissions will not exceed the *de minimus* thresholds of 100 tons per year for NO_x and 50 tons per year for VOC; therefore, each of the four alternatives will conform to the State Implementation Plan. The project will not trigger either a PSD or a non-attainment new source review. Major source emissions thresholds in Massachusetts are 50 tons per year for NO_x and VOC. The preferred alternative with the existing permitted combustion sources will not trigger Title V Operating Permit review.

If stand-alone chillers are utilized to cool the replacement facility, MIT LL will utilize R-134a or another EPA-approved non ozone-depleting substance. The proposed stationary sources (i.e., boilers and generators) are estimated to result in the generation of approximately 5,600 to 6,770 tons/year of CO_2 emissions. When compared to regional emissions, the amount of greenhouse gases anticipated to be generated by any of the four alternatives will not exceed a significance threshold.

The Commonwealth of Massachusetts is currently designated as (moderate) non-attainment for ozone and is in "maintenance" of its carbon monoxide (CO) attainment; therefore, a quantitative General Conformity Rule (GCR) analysis has been completed for the Proposed Action and included in the evaluation of anticipated air quality effects for the four alternatives. Based on results from the GCR analysis, the total emissions from stationary sources and construction-related mobile emissions will not exceed the *de minimus* thresholds for VOC, NO_x, or CO. If a federal action meets the *de minimis* requirements, it is exempt from further conformity analysis pursuant to 40 CFR Part 93.153 and is considered to have minimal air quality impacts. A formal conformity determination is not required for the Proposed Action, regardless of the alternative selected and air quality impacts will not be significant.

***Noise* (EA § 4.8, pages 81 – 82):** Construction and demolition activities will result in a short-term increase in noise levels within the vicinity, regardless of the alternative. While the overall duration of construction is expected to be approximately 2 years, the highest construction noise levels are expected to occur during the first phases of construction, when the site is cleared and the foundation is excavated. These elevated noise levels are not likely to significantly disrupt the activities in nearby office and laboratory buildings. No long-term noise impacts are anticipated to result from operation of the proposed replacement facility. Any noise levels generated will be maintained at a level consistent with current Occupational Safety and Health Administration regulations as specified in CFR Title 29, Part 1910.

***Infrastructure* (EA § 4.9, pages 82 – 89):** Regardless of the alternative, construction activities will result in a short-term increase in demand for water supply, sewage treatment, and electricity. Some existing utilities may need to be relocated prior to construction. Construction activities may result in short-term impacts to the storm drainage system due to ground disturbance and temporarily exposed soils that may be carried to the drainage system during heavy storms. Sedimentation and erosion control measures will be implemented prior to, and during, construction to reduce the potential impact. While the project will result in an increase in impervious surfaces, it is not anticipated to result in long term adverse impacts to the storm drainage system, as the design will include storm water BMPs in accordance with HAFB's drainage requirements. Consequently, during operation, no increase in the generation of storm water runoff is anticipated.

New utilities will need to be installed to connect the replacement facility to existing utilities for any of the alternatives. The operation of the proposed replacement facility is anticipated to increase water demand due to the general functions of the building; however, operation will not increase demand for potable water at HAFB beyond the available supply, regardless of the site selected. MIT LL will need to amend its Massachusetts Water Resources Authority (MWRA) Discharge Permit to include the new location from where wastewater will be generated and modify the sampling plan accordingly. The operation of the proposed replacement facility will increase the demand for, and use of, electricity at MIT LL; however, HAFB's electrical demand is well below the capacity of the transmission lines on base. No impacts to fire protection on HAFB or MIT LL are anticipated to result from any of the alternatives.

Since the design of the replacement facility includes a requirement for natural gas, new service laterals will be installed to provide service to the new building. While the HAFB natural gas distribution system currently has capacity limitations, these issues are being addressed by National Grid and HAFB. The use of natural gas within the replacement facility is not expected to increase demand for natural gas at HAFB beyond the anticipated capacity of the distribution system (following upgrades by National Grid and HAFB, as part of a separate action).

If the proposed replacement facility were to obtain heat (via steam) from the HAFB CHP, the estimated maximum demand would range from 8,100 to 13,000 pounds per hour. While some improvements to CHP efficiency and distribution system efficiency have been made in the past decade, there has been no increase in approved capacity. Without a reduction in demand from other users, or further reductions in heat losses from the existing distribution network, connection of the MIT LL replacement facility to the HAFB CHP could increase the number of hours/days when the HAFB CHP must operate all four boilers simultaneously, without any standby capacity. HAFB will require a detailed loading study before authorizing the connection of any new buildings to the CHP. As a result, MIT LL is proposing to provide heat and hot water to the replacement facility via stand-alone boilers to be installed in the new building. If MIT LL utilizes stand-alone boilers, there will be no impact on the HAFB CHP.

It is anticipated the proposed replacement facility will be connected to the MIT LL Chilled Water Plant (CWP), where incremental capacity can be added without significant impact to existing infrastructure. Alternately, MIT LL is also considering the use of stand-alone chillers. If stand-alone units are employed, there would not be a need to increase the capacity at the MIT LL CWP.

Transportation **(EA § 4.10, pages 89 – 93):**

Traffic. Impacts to transportation systems at/near HAFB and MIT LL during construction will be minimal. Increased activity in the vicinity of the four alternative sites, including connection of new facilities to existing utilities, may temporarily disrupt local traffic on HAFB and/or MIT LL; however, no impact to off-base roads is anticipated. During operation, the proposed replacement facility will not result in the generation of any new trips onto HAFB or MIT LL and is not expected to contribute to traffic delays in the area.

Parking. Recognizing the existing parking conditions on base are not optimal, MIT LL, in cooperation with HAFB, recently conducted a parking study that addressed the entire MIT LL campus (AECOM, 2013d). The findings of the parking study were applied to each alternative to determine whether enough parking spaces will be available to satisfy parking demand. The site for the Preferred Alternative (C/J Lot) is currently used as a parking area. Construction of the proposed facility at the Preferred Alternative (C/J Lot) will result in the permanent displacement of approximately 205 existing parking spaces near the existing J Building; during construction, an additional 42 spaces will be unavailable for use, which will be restored following construction. MIT LL is considering providing signage for some of the remaining spaces in the C/J Parking Lot to allow for dedicated spaces for Building 1305 (Brown Building), as this is an HAFB customer service facility, which includes retiree services. Construction of the Alternative 2 (J Building) would result in the permanent displacement of

approximately 230 existing parking spaces near the existing J Building. Regardless of which site is selected; sufficient parking capacity is anticipated to exist to satisfy parking demand, although walking distances may increase for some employees. No existing parking spaces would be displaced by construction of the replacement facilities if Alternative 3 (Hillside at Gate 3A) or Alternative 4 (AFRL Open Field) were selected.

***Solid Wastes and Hazardous Materials* (EA § 4.11, pages 93 – 96):** For Alternative 2 (J Building), prior to demolition of the existing J Building, a licensed Asbestos Inspector would complete a full building demolition asbestos inspection. Construction and demolition debris will be segregated from hazardous materials requiring special disposal in accordance with federal and state regulation, including any materials that may potentially contain PCBs or mercury. Construction activities will generate solid waste, primarily associated with packaging of construction materials. To the extent practicable, construction will utilize reused or recycled materials. During construction, hazardous materials and waste will likely be used and generated, including: equipment fuel, engine oil, hydraulic oil, grease, and other equipment operation and maintenance material. Any hazardous materials used during construction will be used, stored, transported, and disposed in accordance with MIT LL policies and protocols and relevant state and federal regulations.

Operation of the replacement facility is not expected to result in a significant increase in the volume of solid waste generated by MIT LL. Routine operations of the replacement facility will require the occasional use of toxic solvents or gases. Purchase requisitions for hazardous chemicals, biological materials, and toxic gases will be routed through the MIT LL Environmental Health and Safety (EHS) Office for review and approval. It is anticipated that a storage area may be located within the proposed replacement facility for the delivery of chemicals by the case and then distributed to the proposed MIT LL building, or MIT LL may utilize a just-in-time delivery from chemical supply vendors with shipments made directly to the proposed building. The disposal of all MIT LL hazardous wastes will be coordinated through the Lincoln Laboratory Hazardous Waste Facility Personnel. Emergency generators will be installed outside the proposed building and will have an associated aboveground 2,000 gallon diesel fuel storage tank. Operation of the emergency generators will result in periodic generation of waste oil/lubricants; however, substantial quantities are not anticipated.

***Socioeconomic Conditions* (EA § 4.12, pages 96 – 97):** Construction activities will generate a small benefit for the construction industry, as there will be a corresponding short-term increase in the demand for skilled workers and construction materials. Although a slight short-term increase in revenue generated in the surrounding area may occur due to construction employees utilizing local business for supplies and personal use, construction of the replacement facility is not expected to significantly impact the socioeconomic conditions at HAFB or MIT LL, regardless of the alternative. Implementation of any of the four alternatives will simply relocate personnel from one building on MIT LL / HAFB to another. Independent of other activities at HAFB, the replacement facility is not expected to result in the creation of any new long-term jobs. Similarly, none of the four alternatives will have an impact on the population or housing of MIT LL, HAFB, or the surrounding communities. The proposed replacement facility is not expected to have significant human health or environmental impacts. Access to the replacement facility will be restricted to credentialed professionals; no disproportionate environmental health or safety risks to children will occur. Therefore, the proposed project is consistent with the objectives of Executive Orders 12898 and 13045.

***Safety and Occupational Health* (EA § 4.13, pages 97 – 99):** Regardless of the alternative, construction activities will comply with applicable federal, state, local, and applicable USAF regulatory safety standards. It is expected that the construction workers will be trained to identify and avoid safety hazards. A temporary chain link fence will be installed around the perimeter of the construction area, and only authorized personnel with appropriate personal protective equipment will be allowed to enter the construction zone. Operation of the proposed replacement facility will comply with MIT LL EHS policy to promote safety for MIT LL employees, other users, and the general public. If an employee is injured while working, MIT Medical Department personnel, MIT LL Security, and the Hanscom Fire Department EMT responders will assist with medical first-aid treatment and coordinate medical transport to a local hospital or clinic, if necessary.

***Aesthetics* (EA § 4.14, pages 99 – 100):** During construction activities, the presence of cranes and other heavy construction equipment will alter a portion of the view shed from nearby buildings within the MIT LL campus and HAFB, regardless of the alternative. Short-term aesthetic impacts due to construction will be consistent with the developed nature of a military installation. It is not anticipated that construction equipment will be visible from off-base residential locations. The proposed replacement facility will alter the view shed of the surrounding area by adding a new three-dimensional, man-made feature. However, the overall aesthetic character of the area will continue to reflect a mix of office buildings, laboratories, and other industrial uses that comprise the military installation. It is expected that the proposed replacement facility will reflect the modern style of newer buildings on HAFB and the MIT LL campus, while incorporating architectural finishes enabling it to blend with the remainder of the developed landscape on HAFB.

***Cumulative Impacts* (EA § 4.15, pages 100 – 104):** The Proposed Action, combined with other ongoing or proposed activities at HAFB, has the potential to result in minor short-term increases in traffic, noise levels, emissions, and solid waste generation; however, the effects will generally be limited to the construction timeframe of each project and be proportional to the size of the building being constructed or renovated. Overall, the Proposed Action will not result in, or contribute to, significant negative cumulative impacts to the resources on HAFB or in the region. Recently completed projects within the general vicinity of the proposed action on HAFB include Phase I of the replacement Massachusetts National Guard Joint Force Headquarters (JFHQ) facility located along Grenier Street and Randolph Road. Phase I comprised the construction of a 114,000 sf multistory, masonry building and associated parking and storm water detention. Phase II, currently under construction, comprises a 79,000 sf addition to the building. Although the JFHQ project has natural resources impacts associated with tree clearing, it is not anticipated that the combination of the construction of the JFHQ, the MIT LL replacement facility [at the Preferred Alternative (C/J Lot)], and additional ongoing and future HAFB projects will result in significant cumulative impacts regarding the loss of natural resources or the conversion of land use. Additionally, MIT LL has initiated conceptual planning for the Phase 2 Replacement Facilities. At this time, the preferred location for Phase 2 has not been determined, but it is anticipated to be selected from the remaining alternatives evaluated, but not selected for Phase 1, or may include a parcel in Upper AFRL suggested by HAFB. If Phase 2 were to be proposed on the Hillside at Gate 3A and thus result in the clearing of trees, MIT LL recognizes that the cumulative effect (e.g., JFHQ + MIT LL Phase 2) could be significant. In this event, MIT LL anticipates providing appropriate mitigation, in coordination with HAFB, to offset the impact such that the project would qualify for a "mitigated FONSI (Finding of No Significant Impact)" concluding that the project's adverse impacts would be reduced to a less-than-significant level via mitigation conditions.

***Consultation, Coordination and Public Involvement* (EA § 6.0, page 113; Appendix A):** The federal agencies coordinated with this project include the U.S. Fish and Wildlife Service. The state agencies coordinated with this project include the Massachusetts Department of Fish and Game Natural Heritage and Endangered Species Program (NHESP) and the MHC. A public notice was placed in the *Lexington Minuteman*, the *Lincoln Journal*, the *Bedford Minuteman*, and the *Concord Journal* on March 27, 2014 and in the *Hansconian* on March 28, 2014 announcing the availability of the Draft EA and Draft FONSI for public review and comment, with comments due to Hanscom AFB by close of business April 28, 2014. Copies were also available at the HAFB Library and at the Lexington, Lincoln, Bedford, and Concord public libraries. No public comments on the Draft EA and Draft FONSI were received during the 30-day comment period.

Hanscom AFB, on behalf of MIT LL, submitted a project notification form on February 13, 2012 to initiate coordination with Massachusetts Historical Commission (MHC) relative to MIT LL's proposed action. MHC responded on March 14, 2012 acknowledging that some alternatives would result in new construction within the historic district and that there should be continued consultation, including a review of the proposed design of the new facility. MHC also requested MIT LL coordinate with a number of potentially interested parties including the historical commissions and boards of selectmen of Bedford, Concord, Lexington, and Lincoln, as well as the Hanscom Area Towns Committee and the Minute Man National Historic Park. Subsequently in June 2012, MIT LL

provided the project notification form to these potentially interested parties. MIT LL received one response; i.e., the Lincoln Historical Commission noted that it does not have any direct jurisdiction over the project, but requested that awareness be given to areas of archaeological sensitivity and to historic stone walls.

FINDING OF NO SIGNIFICANT IMPACT

In accordance with Council of Environmental Quality regulations implementing the National Environmental Policy Act of 1969, as amended, and Environmental Impact Analysis Process, 32 CFR 989, the USAF concludes that the Preferred Alternative (C/J Lot), Alternative 2 (J Building), and Alternative 4 (AFRL Open Field) are acceptable from an environmental perspective. Based upon my review of the facts and analyses contained in the attached EA (MIT LL Facilities Replacement on HAFB Phase 1) and as summarized above, I find the Proposed Action to initiate Phase 1 of the MIT LL facilities replacement will not have a significant impact on the natural or human environment; therefore, an environmental impact statement (EIS) is not required. This analysis fulfills the requirements of NEPA, the President's Council on Environmental Quality 40 CFR §§1500-1508 and the Air Force EIAP regulations 32 CFR §989.

JEFFREY M. TODD, Colonel, USAF, P.E.
Command Civil Engineer
Communications, Installations
and Mission Support

DATE: 24 July 2014

ENVIRONMENTAL ASSESSMENT
MIT LINCOLN LABORATORY
FACILITIES REPLACEMENT - PHASE 1

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

LIST OF FIGURES

Table of Contents (continued)

LIST OF TABLES

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

AAQS	Ambient Air Quality Standards
ACM	asbestos containing material
ACS	American Community Survey
AFB	Air Force Base
AFI	Air Force Instruction
AFCRL	Air Force Cambridge Research Laboratories
AFMC	Air Force Materiel Command
AFOSHSTD	Air Force Occupational Safety and Health Standard
AFRL	Air Force Research Laboratory
AFRPA	Air Force Real Property Agency
AICUZ	Air Installation Compatibility Use Zone
ANG	Army National Guard
AST	Aboveground Storage Tank
AT/FP	Anti-terrorism/Force Protection
bgs	below ground surface
BMP	Best Management Practice
BRAC	Base Realignment and Closure
BTEX	Benzene, toluene, ethylbenzene, and xylenes
C&D	Construction and Demolition
CAA	Clean Air Act
CE	Civil Engineering
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH_4	Methane
CHP	Central Heat Plant
CIP	Capital Improvements Plan

CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalents
CSL	Compound Semiconductor Laboratory
CWP	Chilled Water Plant
dB	Decibel
DHS	Department of Homeland Security
DoD	Department of Defense
DoDI	Department of Defense Instruction
DRMO	Defense Reutilization and Marketing Office
EA	Environmental Assessment
EHS	Environmental Health & Safety
EIR	Environmental Impact Report (state)
EIS	Environmental Impact Statement (federal)
EMCS	Energy Management Control System
ENF	Environmental Notification Form
EO	Executive Order
EPA	Environmental Protection Agency
EPF	Engineering and Prototyping Facility
ERP	Environmental Restoration Program
ESC	Electronics System Center
EUL	Enhanced Use Lease
FAA	Federal Aviation Administration (Dept. of Transportation)
FAR	Federal Aviation Regulations
FamCamp	Family Camp
FCA	Facilities Condition Assessment
FFRDC	Federally Funded Research & Development Center
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act

GHG	Greenhouse Gas
gsf	gross square feet
HAFB	Hanscom Air Force Base
HARM	Hazard Assessment Rating Methodology
HAZMAT	Hazardous Materials
IRP	Installation Restoration Program
ISR	Intelligence, Surveillance, and Reconnaissance
JFHQ	Joint Force Headquarters
kW	Kilowatt
kWh	Kilowatt hour
kV	Kilovolt
LCMC	Life Cycle Management Center
LEED	Leadership in Energy and Environmental Design
LOS	Level of Service (traffic)
LOS	Line of Sight
LPS	Low Pressure Steam
m/sec	Meters per second
MA	Massachusetts
MA ANG	Massachusetts Air National Guard
MassDEP	Massachusetts Department of Environmental Protection
Massport	Massachusetts Port Authority
MBTA	Migratory Bird Treaty Act
MBTA	Massachusetts Bay Transportation Authority
MCF	1,000 cubic feet (M denotes mil, thousand)
MEPA	Massachusetts Environmental Policy Act
mgd	million gallons per day
MHC	Massachusetts Historical Commission
MIF	Microsystem Integration Facility
MILCON	Military Construction
MIT	Massachusetts Institute of Technology

MIT LL	Massachusetts Institute of Technology Lincoln Laboratory
MPE	Maximum Permissible Exposure
MS4	Municipal Separate Storm Sewer System
MSDS	Material Safety Data Sheets
MSL	Mean Sea Level
MW	MegaWatt
MWRA	Massachusetts Water Resources Authority
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics & Space Administration
NECTA	New England City & Town Areas
NEPA	National Environmental Policy Act
NHESP	Natural Heritage & Endangered Species Program
NOAA	National Oceanic & Atmospheric Administration
NOI	Notice of Intent
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PAL	Public Archaeology Laboratory
PCBs	Polychlorinated Biphenyls
PEL	Personal Exposure Limit
PM	Particulate Matter
ppb	parts per billion
PPE	Personal Protective Equipment
PSD	Prevention of Significant Deterioration
psig	pounds per square inch - gauge
Q-D	Quantity-Distance

R&D	Research & Development
RCP	Reinforced Concrete Pipe
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SAP	Satellite Accumulation Point
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheets
sf	square feet
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
sq mi	square mile
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
TPY	Tons Per Year
TSCA	Toxic Substances Control Act
UFC	Unified Facilities Criteria
USEPA	United States Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
USAF	United States Air Force
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
UST	Underground Storage Tank
VC	Vitrified Clay
VOCs	Volatile Organic Compounds
W	Watts

1.0 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

The Massachusetts Institute of Technology (MIT) is a Massachusetts non-profit educational corporation. MIT Lincoln Laboratory (MIT LL), which is a part of MIT, is a Department of Defense (DoD) federally funded research and development center (FFRDC) operated and managed by MIT. MIT LL's mission is to apply advanced technology to problems of national security that involve research and development activities that focus on long-term technology development as well as rapid system prototyping and demonstration. MIT LL works with industry to transition new concepts and technology for system development and deployment.

Research at MIT LL is aligned within key mission areas that have a specific focus; however, the mission-oriented work supports cross-divisional, multidisciplinary collaborations. The research includes projects in air and missile defense, space surveillance technology, tactical systems, biological-chemical defense, homeland protection, and communications and information technology. The areas that constitute the core of the work performed at MIT LL are sensors, information extraction (signal processing and embedded computing), communications, and integrated sensing and decision support, all supported by a broad research base in advanced electronics. MIT LL takes projects from the initial concept stage, through simulation and analysis, to design and prototyping, and finally to field demonstration.

MIT LL also undertakes government-sponsored, non-defense projects in areas such as the development of systems the Federal Aviation Administration (FAA) relies on to improve air-traffic control and air safety, systems that the National Oceanic and Atmospheric Administration (NOAA) uses in weather surveillance, and systems that the National Aeronautics and Space Administration (NASA) employs in its space science missions.

MIT LL occupies approximately 100 acres on the eastern perimeter of Hanscom Air Force Base (HAFB) in Massachusetts (Figure 1-1). The majority of MIT LL's facilities are on federal property, while 20 of the acres utilized are MIT LL property, commonly referred to as the "Katahdin Hill" area, contiguous with HAFB. The MIT LL property and most of the Laboratory's facilities are within the Town boundaries of Lexington. The original buildings that MIT LL moved into in the early 1950s are still in use. In the early 1990s, MIT LL, which had expanded into nearby rental properties (in Lexington), undertook a construction project to consolidate its facilities. This resulted in the approximately 500,000 square-foot South Laboratory (Building S) and an adjacent parking garage. Currently, MIT LL occupies and maintains 26 buildings on the Lexington campus. The total interior area of these 26 buildings is approximately 1,884,500 square feet (sf). In September 2011, several buildings on the former Air Force Research Laboratory (AFRL) campus, adjacent to Katahdin Hill in the Towns of Lincoln and Lexington, were made available for MIT LL's use. The AFRL buildings (Figure 1-2) were vacated by HAFB as part of the Department of Defense's most recent round of Base Realignment and Closure (BRAC). MIT LL is still in the process of assessing

these buildings for potential occupancy, as major renovations are anticipated to be necessary in most/all of these buildings.

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

Replacement facilities are needed to support MIT LL as a state-of-the-art research facility. Since the inception of the MIT LL campus in the early 1950s, numerous renovations have been completed throughout the campus, often constrained by aging building and systems infrastructure. Many buildings reflect a sharp contrast to the sophisticated equipment and technologies of the research that is being accommodated. Continued occupancy in many of the existing buildings will require significant investment (even for deferred maintenance), yet with no inherent functional improvements to support state-of-the-art research. As described in the following section, continued occupancy and/or renovation were determined not to be viable alternatives, and MIT LL must build new replacement facilities to meet the following five goals:

- Consolidate and provide new state-of-the-art space for the Compound Semiconductor Fabrication Facility.
- Consolidate and provide new state-of-the-art space for the Microelectronics Packaging and Assembly Facility.
- Streamline, decompress, and provide new state-of-the-art space for the Fabrication Engineering and Rapid Prototyping Groups.
- Vacate E and I Buildings due to impending infrastructure failures (mechanical, electrical, and plumbing services are antiquated and highly challenging to repair/upgrade due to lack of building support space).
- Maintain a cohesive connected campus to encourage an open research environment within a secured location.

In 2008, MIT LL had an independent consultant (FEA) perform a Facilities Condition Assessment (FCA) on the 26 buildings within the MIT LL campus (Appendix C)(MIT LL, 2008). The assessments included the following components: site, exterior, roofs, mechanical, electrical, plumbing, fire/life safety, interiors, and exteriors. The results of the FCA indicated that no buildings on campus were in excellent condition, and only four buildings rated as in good condition. Four buildings scored as fair condition, and three buildings ranked as poor, while the remainder (i.e. the majority) were identified as being in below average condition, which is not unexpected considering that the average age of buildings on the MIT LL campus exceeds 40 years and the fact that MIT LL has, in the past, not always had sufficient funding available to keep up with the growing deferred maintenance of the buildings. On a square footage basis, approximately 39% of the laboratory space corresponded to the below average condition, with 13% being fair, and 6% being poor. The remaining 42% of MIT LL's existing square footage of building space, of which the comparatively newer South Lab represents a significant portion, was rated as being in good condition (MIT LL, 2008). That said, many of the building systems will be reaching the end of, or have already surpassed, their useful functional life and need immediate replacement with buildings that are designed to serve MIT LL's research needs.

Figure 1.2-1 Location of MIT Lincoln Lab Campus on Hanscom Air Force Base

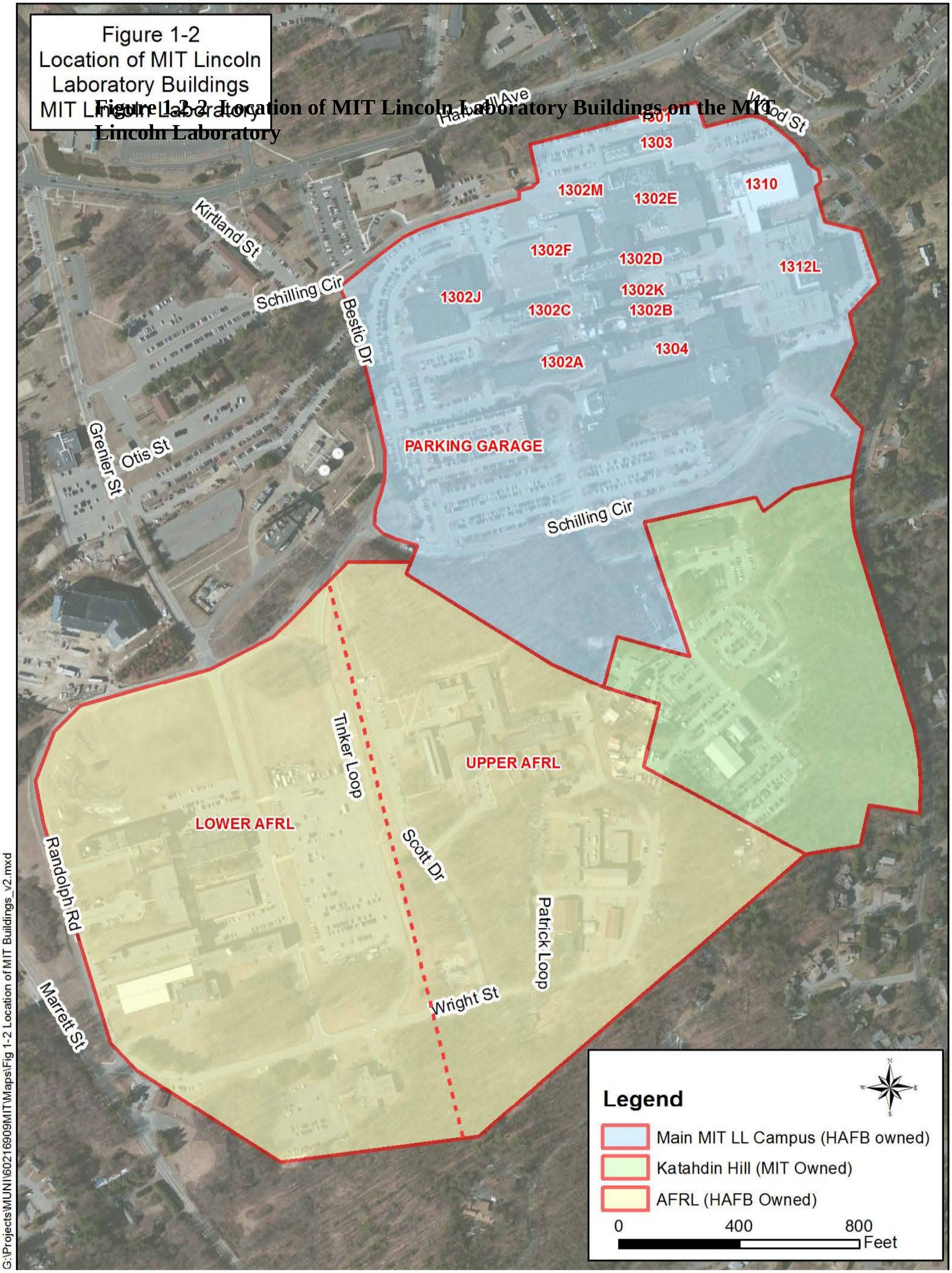


Figure 1-2 Location of MIT Lincoln Laboratory Buildings on the MIT Lincoln Laboratory

As part of the FCA, FEA also performed a risk assessment on the buildings within the MIT LL campus in 2008 (MIT LL, 2008). The building risk level considers the potential impact to the health and safety of the building occupants and the operation of critical programs due to failure of the systems, as well as increased maintenance and repair costs for aging systems. Building risk was determined by evaluating the systems with regard to age, estimated useful life (design life), industry standard system degradation curves, condition, maintenance history, probability of failure, and other factors. The results of the risk assessment reflected trends similar to the FCA. Only four buildings were identified as having low likelihood of business disruption due to potential systems failure. Six buildings were identified as having medium risk, and the remainder (i.e. the majority) were considered to have a high probability of causing business disruptions due to potential facility systems failures.

The FCA concluded that more than $242,000,000 needs to be expended during the next 20 years for "repairs and replacements that should have already been completed" (MIT LL, 2008; MIT LL, 2010).

Subsequently in September 2009, MIT LL performed a function assessment of the 26 existing buildings entitled the "Refresh Study", which is summarized in the MIT LL Conceptual Site Master Plan Study prepared by Payette (Appendix D)(MIT LL, 2010). The report found significant functional constraints with most of the existing buildings when compared to the current basic design guidelines for science research facilities. The criteria for this assessment were based on architecture and structural design (physical and dimensional characteristics) including bay size (the distance between column center lines across the length of a building), zone depth (the width of contiguous space spanning between the exterior wall and corridor wall or the opposite exterior wall or between two parallel corridor walls), and floor-to-floor space (the vertical dimension between the top of the finished floor slabs of two consecutive building levels). The function assessment determined that the majority of buildings on MIT LL's campus have outlived their functional usefulness, especially in the context of new design concepts based on flexibility, adaptability, and sustainability (MIT LL, 2010).

Currently, the conditions are such that laboratory and support space are intermixed. This creates an environment in which researchers cannot perform their work in an efficient manner. Additionally, the buildings and spaces in which the laboratories are located were not designed, nor ever imagined, to house the type of research that is occurring in them. Given consideration of these factors, the current research processes are not streamlined, are inefficient, and are limited due to factors such as vibration sensitivity, radio frequency (RF) and electromagnetic interference (EMI), equipment heights and weights, etc.

In order to meet mission demands, MIT LL proposes to construct approximately 500,000 sf of new replacement facilities. Due to the distinct nature of the two replacement facilities proposed to meet MIT LL's mission needs: a Compound Semiconductor Laboratory/Microelectronics

Integration Facility (CSL/MIF) and an Engineering and Prototyping Facility (EPF), it was determined that the two replacement facilities were not compatible facilities to be located within one building. A CFL/MIF requires very little variances in motion, while an EPF often employs shakers to test prototypes. Based on the alternative sites available for construction evaluated in this EA (MIT LL Facilities Replacement on HAFB Phase 1), the construction of two buildings will likely require the use of two sites, i.e. two separate buildings will not fit within any of the proposed alternatives sites. The distinct and independent utility of the two replacement facilities, coupled with site logistics and program logistics (i.e. the phasing/staging that would be required to shut down and relocate programs prior to the commencement of construction activities), suggest that these program moves likely cannot be conducted simultaneously and efficiently without potential impact to ongoing R&D and the mission of MIT LL. Additionally, the financing of the project has not been fully determined; therefore, it is not known at this time whether both projects will be financed simultaneously and/or whether it is advantageous to use two sources of financing or two different financing structures to undertake these projects. Thus, the construction of 500,000 sf cannot be accomplished at one time, thereby MIT LL proposes to implement the project in two phases. Phase 1 includes the construction of a 145,000 to 175,000 sf replacement facility (depending on the site selected), and Phase 2 would include the construction of an approximately 325,000 sf replacement facility.

The Proposed Action described in this EA (MIT LL Facilities Replacement on HAFB Phase 1) comprises the Phase 1 Facilities Replacement, which is anticipated to house the CSL/MIF. Phase 2, if implemented, is anticipated to be constructed at one of the locations considered (but not selected) for Phase 1 or at a new location (e.g. potentially within the former AFRL) that may be suggested during ongoing siting investigations. MIT LL and HAFB have committed to preparing a second NEPA document (Environmental Assessment) to evaluate the potential impacts of Phase 2, once MIT LL is able to move forward.

While MIT LL is a FFRDC, MIT LL is not a federal agency per NEPA (40 CFR § 1508.12**)**[1]. The development of replacement facilities for MIT LL will require HAFB to execute a land lease with MIT since the action is taking place on HAFB property. Thus, HAFB is the lead agency for the Proposed Action, from a NEPA perspective.

1.3 SUMMARY OF PROPOSED ACTION

Phase 1 comprises the construction of one building, which would provide approximately 145,000 to 175,000 sf of floor space, depending on the location selected. At the earliest, construction is anticipated to begin in the spring of 2015 and be completed within 2 years. Occupancy of the building is anticipated shortly thereafter.

---

[1] An FFRDC is sponsored by a government agency but is not itself a government agency. MIT LL is part of MIT not a federal agency.

Depending on the alternative site selected, the proposed space is anticipated to include a mix of Class 10, 100, 1000, and 10,000 clean rooms (referring to the controlled level of contaminants such as dust, airborne microbes, aerosol particles and chemical vapors, as specified by the number of particles per cubic meter at a specified particle size), with mechanical, electrical and plumbing support rooms and offices.

Existing MIT LL functions would be relocated into the proposed space. The replacement space would allow MIT LL to vacate, and then repurpose or demolish some of the existing buildings within the aging MIT LL campus. The project would allow MIT LL to relocate some functions which have become highly compressed or fragmented, and would result in a more efficient, purpose-built research & development laboratory space, with a greater square footage of research space per employee. The proposed replacement facility would be occupied by existing employees (and equipment[2]) that would relocate from existing buildings, which in turn would enable other employees/equipment in compressed or disjointed space to relocate into the vacated buildings (after renovation). Consequently, construction of the proposed replacement facility would realign the current shortfall of research space per scientist closer to industry standards. As such, the project does not propose, nor would it result in, an increase in employees at MIT LL.

1.4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The Proposed Action addressed in this Environmental Assessment (EA), titled MIT LL Facilities Replacement on HAFB Phase 1, is the construction of a new building for MIT LL to house replacement laboratory, office, and/or administrative facilities for MIT LL at HAFB. This EA (MIT LL Facilities Replacement on HAFB Phase 1) addresses the site-specific impacts of constructing the replacement facility, along with demolition of existing buildings (if necessary to support construction), and evaluates the environmental impacts of building operation, on both the natural and man-made environments. The proposed project would occur on HAFB within the town boundaries of Lexington and/or Lincoln, Massachusetts (depending on the location selected for the replacement facility).

The EA is a written analysis which serves to (1) provide analysis sufficient to determine whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI); and (2) aid federal agencies in complying with NEPA when no EIS is required. If this EA (MIT LL Facilities Replacement on HAFB Phase 1) were to determine the Proposed Action would significantly degrade the environment, significantly threaten public health or safety, or generate significant public controversy, then an EIS would be completed. An EIS involves a comprehensive assessment of project impacts and alternatives and a high degree of public input. Alternatively, if this EA (MIT LL Facilities Replacement on HAFB Phase 1) results in a FONSI, then the action would not be the subject of an EIS. The level and extent of detail and analysis in

[2] MIT LL plans to assess age/condition of the existing laboratory equipment. Equipment that is determined to be obsolete will not be relocated, and will be replaced with new equipment in the replacement facility.

the EA is commensurate with the importance of the environmental issues involved and with the information needs of both the decision-makers and the general public.

1.5 APPLICABLE ENVIRONMENTAL REGULATIONS AND REQUIRED COORDINATION

This EA (MIT LL Facilities Replacement on HAFB Phase 1) addresses the Proposed Action and the No Action alternative in accordance with the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321-4347), Council on Environmental Quality (CEQ, 1978) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] § 1500-1508), and 32 CFR 989 et seq., *Environmental Impact Analysis Process*. In addition, this EA evaluates the compliance of the Proposed Action with potential requirements of the following federal environmental laws and regulations:

- Clean Air Act
- Clean Water Act
- Pollution Prevention Act of 1990
- National Historic Preservation Act
- Archaeological Resources Protection Act
- Endangered Species Act of 1973
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Resource Conservation and Recovery Act (RCRA)
- Toxic Substances Control Act (TSCA) of 1970
- Occupational Safety and Health Administration (OSHA) regulations
- Executive Order (EO) 11988 (Floodplain Management)
- EO 11990 (Protection of Wetlands)
- EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 13514 (Federal Leadership in Environmental, Energy, and Economic Performance)

NEPA implementing regulations require coordination with relevant federal, state, and local agencies to evaluate the potential environmental impacts of implementing the alternatives. MIT LL is coordinating with regulatory agencies, including the Massachusetts Department of Fish and Game Natural Heritage and Endangered Species Program (NHESP), Massachusetts Historical Commission (MHC), and U.S. Fish & Wildlife Service (USFWS). Since the Proposed Action would be undertaken by MIT LL but occur on DoD property, this EA (MIT LL Facilities Replacement on HAFB Phase 1) is being prepared by MIT LL on behalf of HAFB. The EA is being reviewed by the U.S. Air Force, including the environmental planning organizations at HAFB and the Air Force Materiel Command (AFMC) headquarters.

1.6 REQUIRED PERMITS AND LICENSES

Environmental permitting requirements for all work on HAFB are coordinated through the Civil Engineering - Environment department, the office overseeing environmental issues at HAFB. A Base Civil Engineering Work Clearance Request, known as a "dig permit", is necessary for any work that may disrupt vehicular traffic flow, base utility services, protection provided by fire or intrusion alarm systems, or routine activities of the installation. Any and all required permits and/or approvals would be applied for by, and issued in the name of, MIT as the legal entity.

Additionally, the Proposed Action may require the following federal and state permits/approvals (or modifications to existing permits):

- **Environmental Protection Agency (EPA) – National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities**. This Construction General Permit (CGP) authorizes stormwater discharges from construction activities that result in a total land disturbance of one acre or more, where those discharges enter surface waters or a municipal separate storm sewer system (MS4) leading to a surface water.
- **Massachusetts Department of Environmental Protection (MassDEP) – Air Plan Approval**. MIT LL currently has Air Plan Approval from the MassDEP. This Air Plan Approval establishes monthly and annual facility-wide emission limitations for nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter (PM) and sulfur dioxide (SO_2). Depending on the heating and cooling options employed for the replacement facility, it may be necessary to modify/amend the existing Air Plan Approval.
- **Massachusetts Environmental Policy Act (MEPA) – Environmental Notification Form.** The MEPA thresholds (301 CMR 11.03) determine whether it will be necessary to prepare an Environmental Notification Form (ENF) and/or an Environmental Impact Report (EIR). As conceptual design for the replacement facility becomes available, MIT LL will continue to evaluate the project in comparison to the MEPA thresholds. Presently, it does not appear that any MEPA thresholds would be exceeded. However, depending on the location selected and the final design, the proposed project could approach or exceed the following MEPA thresholds requiring preparation of an ENF: 1) land - creation of five or more acres of impervious area, or 2) transportation – construction of 300 or more new parking spaces at a single location.
- **Demolition/Disposal Permits** – If construction of the replacement facility requires demolition of existing buildings, the project is expected to require a permit for the demolition. Construction and demolition (C&D) wastes would be disposed in accordance with MassDEP policies for managing C&D wastes. If demolition is necessary, hazardous materials (such as asbestos) will be removed from the building prior to demolition and transported and disposed in accordance with the Resource Conservation and Recovery Act.

- **Massachusetts Water Resources Authority (MWRA) Sewer Use Discharge Permit –** MIT LL has a Sewer Use Discharge Permit issued jointly by the MWRA and the town of Lexington, since MIT LL discharges wastewater to the MWRA sewerage system via the town of Lexington sewerage system. The permit includes self-monitoring, discharge limitations, mandated sampling locations, analysis, reporting/ notification, and other requirements (Permit # 17100088, issued in 2013; expires in 2015). MIT LL would need to amend its MWRA Discharge Permit to include the new location from which wastewater would be generated and modify the sampling plan accordingly.

With regard to long-term (i.e. operational, rather than construction) stormwater runoff impacts, MIT LL is a co-permittee, with HAFB and Massport, on a NPDES multi-sector general permit. However, this permit relates to the hangar MIT LL occupies on the airfield at HAFB. Stormwater drainage from the MIT LL campus enters into the HAFB drainage network. Thus, the design of drainage for the proposed replacement facility would comply with the Clean Water Act and HAFB's stormwater management policy. Additionally, it should be noted that the US EPA anticipates issuing a new municipal draft permit in 2013 that would likely go into effect prior to construction of the proposed replacement facility. As currently drafted, the permit would require municipalities to implement a revised Stormwater Management Program (SWMP). The new SWMP may contain requirements for stormwater management that could apply to new impervious surface associated with the proposed replacement facility.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

Many facilities on the MIT LL campus are constrained by aging buildings and systems infrastructure and reflect a sharp contrast to the sophisticated equipment and technologies of the research that is being accommodated. Following the various assessments of the substandard conditions of many of its existing buildings and laboratory space, MIT LL is responding to the need to build new state-of-the-art facilities to meet mission demands.

2.2 NO ACTION ALTERNATIVE

The No Action alternative is the baseline for all the rest of the analysis and helps determine the extent to which the Proposed Action would impact the environment. MIT LL has considered "business as usual" (i.e. No Action), in which expenditures would be limited to operating costs and deferred maintenance, and no new facilities would be constructed. Continued occupancy in many of the existing buildings will require significant investment (even for deferred maintenance), with no inherent functional improvements to support state-of-the-art research. No Action was determined by MIT LL to have a potential impact on the health and safety of building occupants and a potential adverse impact on the operation of critical programs due to possible failure of aging systems. In this circumstance, the No Action alternative is roughly equivalent to a "Future Conditions Without the Project" scenario.

2.3 RENOVATION ALTERNATIVE (DISMISSED)

MIT LL considered upgrading the existing laboratory space. As noted in the FCA, many of the buildings would require major renovation to replace the systems infrastructure, i.e. essentially requiring demolition down to the superstructure. Even after renovation, the structure of the existing buildings that would remain would present limitations in terms of structural seismic requirements, architectural bay size, and zone depth. Despite considerable capital costs, renovation of existing laboratory space would still result in laboratory space having constraints that could impede the ability of MIT LL to safely and efficiently execute its mission. Thus, the renovation of existing laboratory space alternative was dismissed by MIT LL because it does not meet the project purpose and need. As this renovation was determined to not be a viable alternative, it is not evaluated further in this EA (MIT LL Facilities Replacement on HAFB Phase 1). Therefore, in order to support continued research and development and to operate under current industry standards and in a more cost effective manner, MIT LL must build new facilities (rather than renovate existing buildings) to meet its mission demands.

2.4 SITE SELECTION AND EVALUATION CRITERIA FOR BUILD ALTERNATIVES

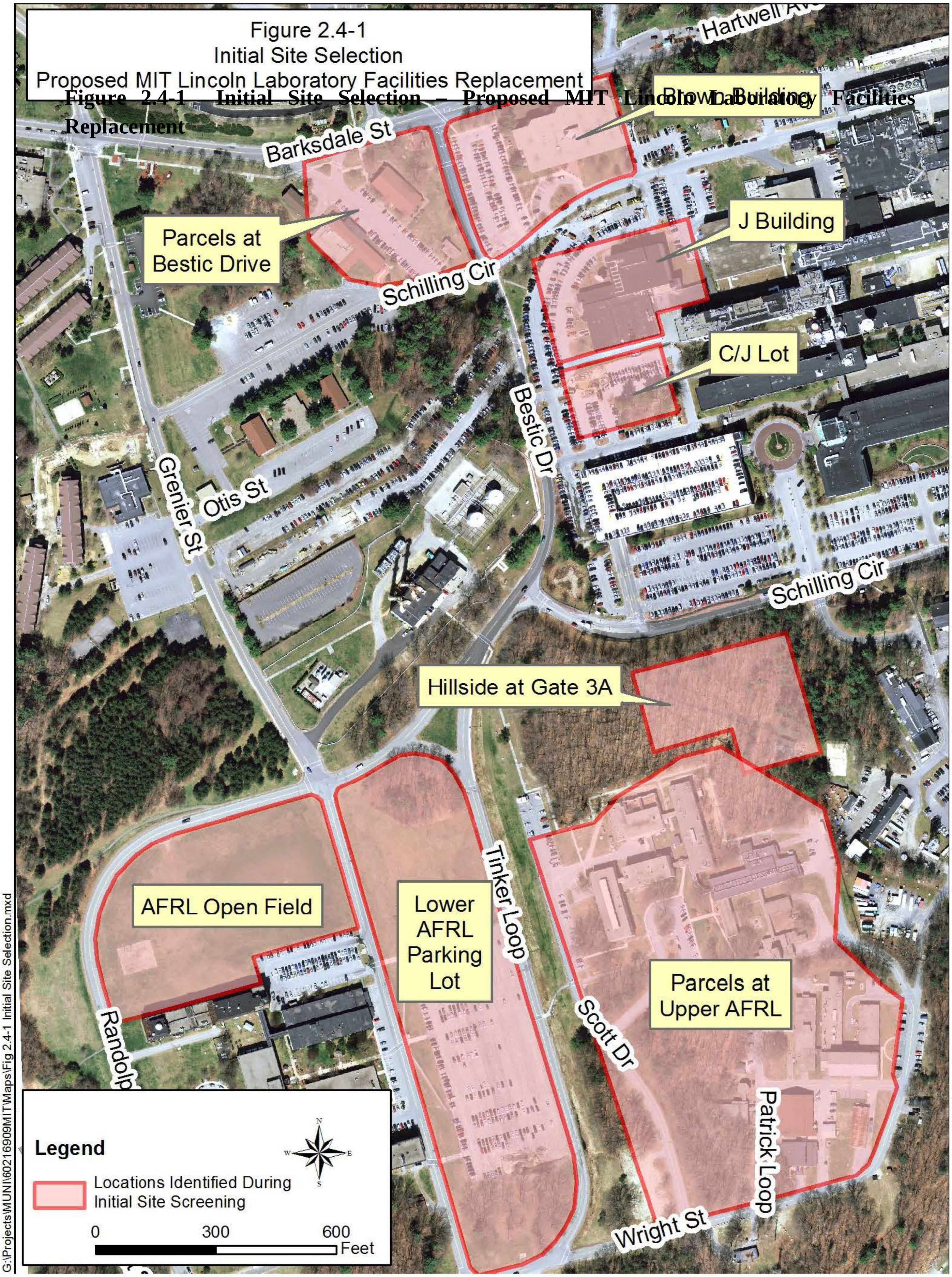
Once it was realized that the only means to achieve the project purpose and need was through the construction of new facilities, MIT LL, in conjunction with HAFB, initiated a site identification and screening process.

Initial site identification focused on identifying parcels on HAFB and/or MIT LL property immediately adjacent, or in close proximity, to the core MIT LL campus. It was recognized that parcels free of existing aboveground facilities would likely be less expensive to build on, as capital expenditures would not be required for demolition and disposal. However, it was also recognized that the reuse/redevelopment of existing parcels could have advantages by reducing some environmental impact (such as creation of new impervious area). Thus, consideration was given to parcels that had no existing aboveground facilities, as well as parcels with existing buildings that would need to be demolished to make room for construction.

The initial site investigations resulted in eight general areas, each at least 2.5 acres in size, for further consideration as a potential location for the Proposed Action, including (as shown in Figure 2.4-1):

- parcel along Bestic Drive containing two small buildings (#1217 and #1218) and associated parking lot along Kirtland Street,
- parcel within the Upper AFRL consisting of seven buildings (#1118, 1126, 1128, 1138, 1140, 1141, and 1142) and surrounding land,
- AFRL Open Field [open space],
- Brown Building (#1305) and its associated parking lot,
- Lower AFRL Parking Lot [no aboveground structures],
- undeveloped hillside south of Schilling Circle (Hillside at Gate 3A),
- Building 1302J (J Building) and adjacent parking area to the north and west, and
- parking area to the south of J Building (C/J Lot).

Figure 2.4-1 Initial Site Selection – Proposed MIT Lincoln Laboratory Facilities Replacement



Each of the proposed locations for the replacement facility was evaluated from the perspective of MIT LL and HAFB considering the ten criteria listed below. MIT LL and HAFB assigned each site an initial score between 1 and 10 (10 being the highest) for each of the criteria (as shown in Tables 2.4-1 and 2.4-2), per the following characterization:

Excellent	Very Good	Good	Average	Poor	Unacceptable
10	9-8	7-6	5-4	3-2	1-0

The initial score assigned to each of the ten criteria in Tables 2.4-1 and 2.4-2 was then multiplied by a weighting factor to achieve a total possible weighted site score of 10 (Tables 2.4-3 and 2.4-4). A total combined score for each site was obtained by summing MIT LL's and HAFB's weighted score (Table 2.4-5). The minimum threshold for consideration was a total combined score of 10 points or more.

- **Mission Impacts**: Extent to which the location would require MIT LL to move/juggle existing equipment and personnel to enable the relocation; potential disruptions to MIT LL's mission and HAFB base operations.
- **Proximity**: Distance from MIT LL entry points and how it effects an overall goal of keeping lab facilities together (nucleus lab concept); six minute walk considered ideal acceptable maximum threshold; the ability to construct a bridge connection to existing facilities considered excellent.
- **Parking and Traffic Disruption**: Temporary or permanent loss of parking capacity; temporary closing of streets; traffic circulation; relocation of facilities (and associated parking demand) to areas outside of the MIT LL congested core parking areas was preferred.
- **Cost to Build**: Total soft costs, construction costs, and site specific costs (e.g. potential need to decommission/demolish existing structures or site size constraints).
- **Schedule**: Timeline to obtain property (including legal clearances), relocate existing MIT LL or HAFB personnel (if necessary), demolish existing facilities (if necessary) and accomplish construction.
- **Security**: Extent to which the site footprints offered sufficient space/flexibility to meet security criteria, particularly setback limitations established in the Unified Facilities Criteria (UFC).
- **Environmental**: Extent to which existing environmental conditions constrain development of the site (e.g. loss of natural resources, presence of hazardous materials, stormwater).
- **Site Orientation**: Orientation of land for building purposes; allowance for building rotation to be more energy-efficient preferred.
- **Size**: Acreage of available land and lot size, with consideration to setbacks and building height limitations; 3 acres considered ideal size.
- **Long-Term Land Use**: Compatibility with long-term land use plans and AFI 32-7062, *Comprehensive Planning*.

Table 2.4-1 Site Selection - HAFB Raw Scores

Criteria	Weight	Parcel along Bestic Drive	Parcel within the Upper AFRL	AFRL Open Field	Brown Building	Lower AFRL Parking Lot	Hillside at Gate 3A	J Building	C/J Lot
Mission Impacts	15%	2	9	7	0	5	6	3	7
Proximity	10%	5	6	4	3	4	7	7	7
Parking/Traffic	15%	3	8	7	1	4	5	2	3
Cost	5%	5	6	7	5	6	3	4	5
Schedule	5%	5	5	6	5	6	3	5	5
Security	10%	2	7	8	2	8	6	7	7
Environmental	15%	5	6	6	5	6	0	7	7
Site/Orientation	5%	5	6	6	0	5	4	6	6
Size	5%	5	8	7	3	7	5	5	5
Long-Term Land Use	15%	1	9	4	1	4	1	8	8
Total	100%	**38**	**70**	**62**	**25**	**55**	**40**	**54**	**60**

Table 2.4-2 Site Selection - MIT LL Raw Scores

Criteria	Weight	Parcel along Bestic Drive	Parcel within the Upper AFRL	AFRL Open Field	Brown Building	Lower AFRL Parking Lot	Hillside at Gate 3A	J Building	C/J Lot
Mission Impacts	15%	9	9	7	8	5	8	3	8
Proximity	20%	7	3	2	8	2	8	10	10
Parking/Traffic	10%	5	8	7	7	3	3	3	3
Cost	5%	5	4	8	2	6	7	3	7
Schedule	5%	4	6	8	3	6	8	3	8
Security	10%	2	5	8	2	8	7	5	5
Environmental	15%	5	4	8	5	7	4	5	8
Site/Orientation	5%	5	6	8	4	3	8	5	5
Size	5%	5	8	8	3	5	7	5	4
Long-Term Land Use	10%	1	9	4	1	4	5	8	8
Total	100%	**48**	**62**	**68**	**43**	**49**	**65**	**50**	**66**

Table 2.4-3 Site Selection - HAFB Weighted Scores

Criteria	Weight	Parcel along Bestic Drive	Parcel within the Upper AFRL	AFRL Open Field	Brown Building	Lower AFRL Parking Lot	Hillside at Gate 3A	J Building	C/J Lot
Mission Impacts	15%	0.3	1.35	1.05	0.0	0.75	0.9	0.45	1.05
Proximity	10%	0.5	0.6	0.4	0.3	0.4	0.7	0.7	0.7
Parking/Traffic	15%	0.45	1.2	1.05	0.15	0.6	0.75	0.3	0.45
Cost	5%	0.25	0.3	0.35	0.25	0.3	0.15	0.2	0.25
Schedule	5%	0.25	0.25	0.3	0.25	0.3	0.15	0.25	0.25
Security	10%	0.2	0.7	0.8	0.2	0.8	0.6	0.7	0.7
Environmental	15%	0.75	0.9	0.9	0.75	0.9	0.0	1.05	1.05
Site/Orientation	5%	0.25	0.3	0.3	0.0	0.25	0.2	0.3	0.3
Size	5%	0.25	0.4	0.35	0.15	0.35	0.25	0.25	0.25
Long-Term Land Use	15%	0.15	1.35	0.6	0.15	0.6	0.15	1.2	1.2
Total	100%	**3.35**	**7.35**	**6.10**	**2.20**	**5.25**	**3.85**	**5.40**	**6.20**

Table 2.4-4 Site Selection - MIT LL Weighted Scores

Criteria	Weight	Parcel along Bestic Drive	Parcel within the Upper AFRL	AFRL Open Field	Brown Building	Lower AFRL Parking Lot	Hillside at Gate 3A	J Building	C/J Lot
Mission Impacts	15%	1.35	1.35	1.05	1.2	0.75	1.2	0.45	1.2
Proximity	20%	1.4	0.6	0.4	1.6	0.4	1.6	2	2
Parking/Traffic	10%	0.5	0.8	0.7	0.7	0.3	0.3	0.3	0.3
Cost	5%	0.25	0.2	0.4	0.1	0.3	0.35	0.15	0.35
Schedule	5%	0.2	0.3	0.4	0.15	0.3	0.4	0.15	0.4
Security	10%	0.2	0.5	0.8	0.2	0.8	0.7	0.5	0.5
Environmental	15%	0.75	0.6	1.2	0.75	1.05	0.6	0.75	1.2
Site/Orientation	5%	0.25	0.3	0.4	0.2	0.15	0.4	0.25	0.25
Size	5%	0.25	0.4	0.4	0.15	0.25	0.35	0.25	0.2
Long-Term Land Use	10%	0.1	0.9	0.4	0.1	0.4	0.5	0.8	0.8
Total	100%	**5.25**	**5.95**	**6.15**	**5.15**	**4.70**	**6.40**	**5.60**	**7.20**

Table 2.4-5 Site Selection - Final Combined Weighted Scores

	Parcel along Bestic Drive	Parcel within the Upper AFRL	AFRL Open Field	Brown Building	Lower AFRL Parking Lot	Hillside at Gate 3A	J Building	C/J Lot
Total Combined	**8.60**	**13.30**	**12.25**	**7.35**	**9.95**	**10.25**	**11.0**	**13.40**

2.5 BUILD ALTERNATIVES DETERMINED VIABLE FOLLOWING SITE SCREENING

As described above, the eight sites were evaluated, resulting in the elimination of four locations. The four locations eliminated from further consideration included: parcel along Bestic Drive, parcel within the Upper AFRL, the Brown Building, and the Lower AFRL Parking Lot for the reasons described below:

The Bestic Drive location received a score below the minimum threshold for consideration (combined weighted score of 8.60), including low scores from MIT LL with respect to security and long-term land use. New construction at this location would displace existing HAFB activities, and thus received a low score for mission impacts from HAFB (score of 2). This location was also rated low by HAFB due to security considerations (score of 2) and long-term land use (score of 1).

The parcel within the Upper AFRL was eliminated due to issues with schedule (e.g. issues tied to acquiring the land, conducting environmental surveys of buildings' interiors, abating environmental hazards, developing a Programmatic Agreement with MHC, performing the anticipated historical mitigation, and demolishing the buildings – all of which would need to occur before building construction and thus could jeopardize MIT LL's goal of occupancy in the replacement facility by 2017). However, because the site scored highly overall, it may be considered for the Phase 2 Facilities Replacement.

The Brown Building received the lowest weighted composite score (7.35 out of 20). MIT LL ranked the site low due to cost, schedule, security, site orientation, and long-term land use. HAFB assigned this site its lowest scores for parking/traffic disruption, security, site orientation, size, long-term land use, and most importantly mission impacts. Use of this site would require relocation of the HAFB services currently provided by offices within the Brown Building.

The Lower AFRL Parking Lot was eliminated because use of the site would potentially create greater parking disruption for HAFB, MIT LL, or other tenants (such as the Joint Forces HQ use of the AFRL parking lot for overflow parking on weekends). This location also received low scores from MIT LL for proximity (initial score of 2).

Thus, four build locations on HAFB, including the C/J Lot, J Building, the Hillside at Gate 3A, and the AFRL Open Field, were determined to be viable following the site screening process and were selected for further analysis. These build alternatives are hereafter referred to as the Preferred Alternative (C/J Lot), Alternative 2 (J Building), Alternative 3 (Hillside at Gate 3A), and Alternative 4 (AFRL Open Field).

2.6 DESCRIPTION OF BUILD ALTERNATIVES

The Proposed Action is the construction of a building to provide replacement laboratory, office, and/or administrative facilities for MIT LL at HAFB in Massachusetts. The proposed building is anticipated to be between 2 to 4 stories tall, depending on the site selected. The proposed replacement facility is currently in conceptual design; however, the exterior design is anticipated to reflect the state-of-the-art research to be conducted within, while having characteristics that are architecturally compatible with the adjacent natural and man-made features on HAFB.

Facility construction would include all necessary components, such as site preparation/grading, pouring of concrete foundation and floor slab, erection of steel support columns and walls, roof assembly, exterior finishing, utility connections, landscaping, and installation of stormwater management measures. For some alternatives, site preparation would include demolition of existing buildings/facilities. The proposed replacement facility would be handicapped accessible, and have systems for fire protection/detection and energy management. Emergency generator(s), having a total output of approximately 1,000 kW, would be installed to provide standby power for the proposed replacement facility. The project would be compliant with DoD force protection, relative to building integrity and safety setbacks. MIT LL is considering design options that reduce the negative environmental impacts of buildings and improve occupant health and well-being, pursuant to water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality. MIT LL anticipates that the proposed building would meet the certification requirements for Leadership in Energy and Environmental Design (LEED) – Silver.

The intended use of the proposed project would include programs from the Advanced Technology Division. The Advanced Technology Division performs research and development on component and subsystem-level technologies that can enable new approaches to DoD systems and that advance the state-of-the-art for U.S. industry. The division's expertise covers a wide front including biology, chemistry, computer science, device physics, integrated circuit design and fabrication, lithography, materials, nanofabrication, optics, optoelectronics, packaging, photonics, quantum information systems, and radio-frequency technology.

The following section describes the proposed replacement facility alternatives and includes a discussion of the heating and cooling options common to all alternatives.

2.6.1 Replacement Facility

Implementation of the Proposed Action would result in an overall increase in net facilities square footage but a decompression of space (i.e. the same number of employees but spread over a greater area). Each of the alternatives entails the construction of an approximately 145,000 to 175,000 sf (depending on the site selected) new facility. The location of these alternatives is depicted on Figure 2.6-1. All alternative sites are located within the town of Lexington, with the

exception of Alternative 4 (AFRL Open Field) which is located partially within the Towns of Lincoln (western portion) and Lexington (eastern portion). All of the alternative sites are presently federal property and would require HAFB to execute a land lease with MIT in order for development to proceed. At the earliest, construction is anticipated to begin in the spring of 2015 and be completed within 2 years from the start date. Occupancy of the building is anticipated shortly thereafter.

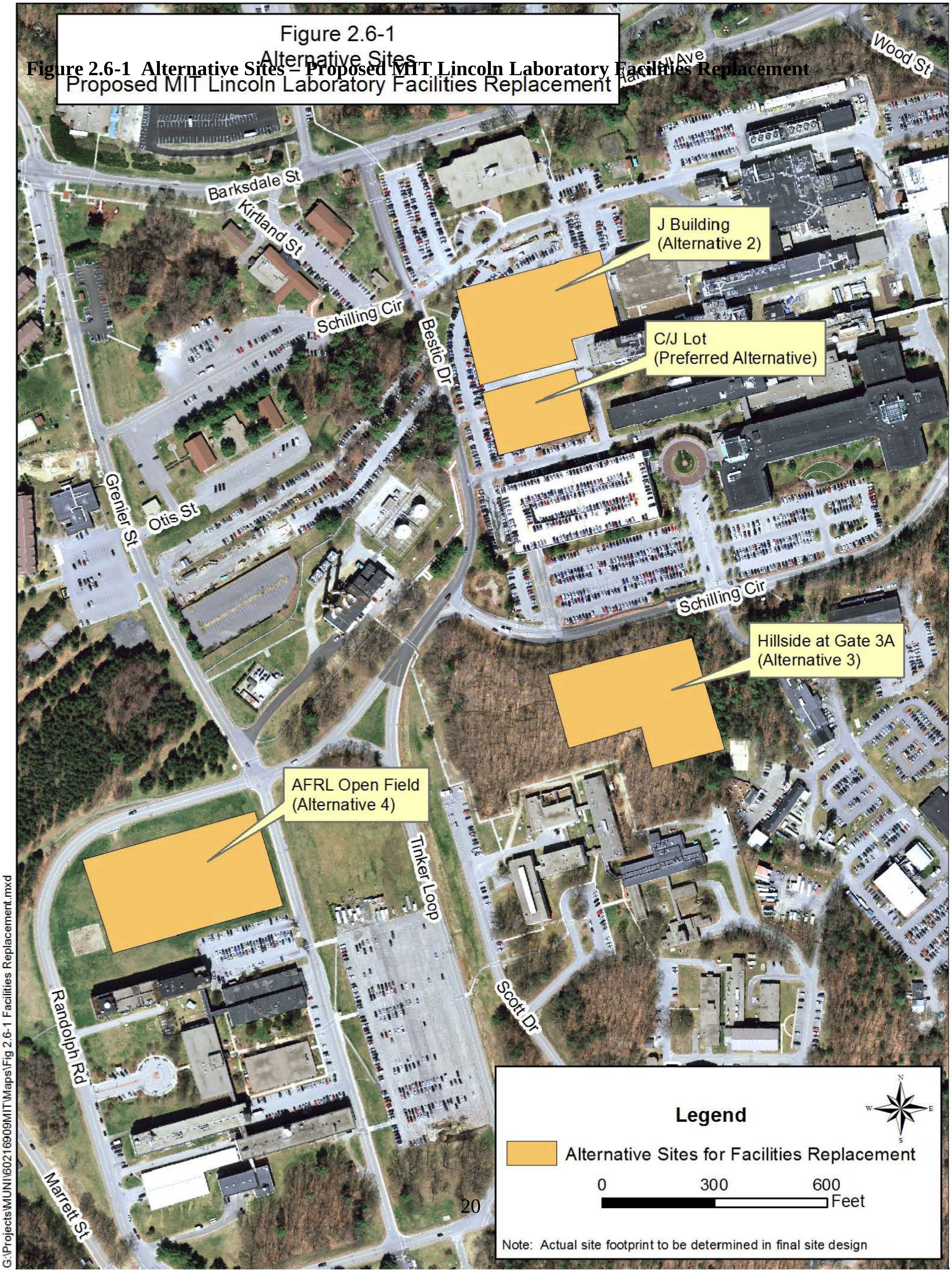
Construction of the replacement facility (Phase 1) would include some, or all, of the following components, depending on the location selected (and the corresponding size constraints):

- Class 10 Clean Rooms – CSL
- Class 100 & 1,000 Clean Rooms – MIF
- Offices

The replacement facility is anticipated to include the following specialty drainage systems:

- Solvent drain: welded stainless steel drain piping system from solvent benches and similar tools, routed to a central drum collection station
- Arsenic drain: welded stainless steel drain piping system from arsenic process areas to a central drum collection station
- Hybrid liquid drain: welded stainless steel drain piping system to a central drum collection station
- Slurry drain: Polyvinyl chloride (PVC) or acrylonitrile-butadiene-styrene (ABS) drain piping routed to a holding tank and ultrafiltration system for solids removal before the permeate is discharged to sanitary drain and the solids slurry is hauled off site for disposal
- Fluoride drain: welded stainless steel drain piping from wet stations processing hydrofluoric acid (HF) to a holding tank and batch treatment system for fluoride removal

Figure 2.6-1 Alternative Sites – Proposed MIT Lincoln Laboratory Facilities Replacement



Preferred Alternative (C/J Lot)

The Preferred Alternative is the construction of a new building of approximately 175,000 sf at the existing C/J Lot, on the west side of the MIT LL campus, to the east of Bestic Drive and immediately south of J Building. The site for the Preferred Alternative (C/J Lot) is currently used as a parking area, which would be displaced by the proposed replacement facility.

It is anticipated that the Preferred Alternative (C/J Lot) would have approximately 100 occupants who would relocate to the Preferred Alternative (C/J Lot) from various buildings on the MIT LL campus: occupants of Buildings C, E, I and L/LI would be relocated to the new building.

MIT LL has selected "C/J Lot" as the Preferred Alternative for the Proposed Action. The Preferred Alternative (C/J Lot) most effectively and cost efficiently addresses the five goals for meeting MIT LL's ongoing and future mission requirements (as described in Section 1.2) for Phase 1 of its Laboratory Facility Replacement.

Alternative 2 (J Building)

Alternative 2 (J Building) is located on the MIT LL campus's western side and is currently occupied by J Building. The existing J Building, which has approximately 75,000 sf of laboratory and office space, is located to the east of Bestic Drive and south of Schilling Circle (the north part of the circle). The proposed building would be constructed within the footprint of the existing J Building and its surrounding parking lot (to the north and west) and is anticipated to be 145,000 to 175,000 sf, consisting primarily of lab space.

In order to construct a new building at this location, the existing J Building must be vacated and demolished. In order to vacate the existing J Building, the following steps for relocation of office/laboratory space and employees from various locations on the MIT LL campus must occur to create the space for relocation of the employees and equipment in the J Building.

- AFRL - A number of office functions at various locations on the MIT LL campus may be relocated to the AFRL buildings recently made available for MIT LL's use.
- Hubs - Office functions would be reorganized at various locations on the MIT LL campus into new Hubs, encompassing approximately 150,000 sf on the MIT LL main campus. These moves would create efficiencies and decompress existing space.

Alternative 3 (Hillside at Gate 3A)

Alternative 3 (Hillside at Gate 3A) would be located south of Schilling Circle (the southern portion of the circle) to the southeast of Gate 3A, within an area that is presently a wooded hillside. The proposed replacement facility at this site would be approximately 175,000 sf,

consisting of lab and office space. An existing walking path within the wooded area would be relocated around the perimeter of the proposed new building.

Alternative 4 (AFRL Open Field)

Alternative 4 (AFRL Open Field) is located on the former AFRL campus to the southwest of the MIT LL campus, to the south and east of Randolph Road and west of Grenier Street, and across the street from the recently constructed Army National Guard Joint Force Headquarters Building. The western portion of the site is located in the town of Lincoln, while the eastern portion is located in the town of Lexington. The proposed building at this location would be constructed within the existing open field. The new building could be between 145,000 sf and 175,000 sf, consisting of lab and office space.

2.6.2 Heating and Cooling Options

Conceptual design of the proposed replacement facility has only recently been initiated. At this time, the preferred methods for heating and cooling the proposed replacement facility have not been finalized.

Presently, steam heat is provided to most buildings on MIT LL by the HAFB central heat plant (CHP). However, during winter months, high heating demands require the HAFB CHP to operate near full capacity (HAFB, 2003). The proposed replacement facility would require a maximum of 8,100 to 13,000 pounds of steam per hour (depending on the alternative), if heat were to be supplied by the Hanscom CHP. No additional infrastructure, other than some connecting steam lines, would be needed if the proposed MIT LL replacement facility were to connect to the HAFB CHP. However, the additional demand from MIT LL's proposed development may meet or exceed the HAFB CHP's reserve capacity, unless other actions[3] are taken to increase capacity or reduce demand elsewhere on HAFB or within the MIT LL campus. For these reasons, additional options for heating the proposed replacement facility are being considered and are summarized below in Table 2.6-1. For the purpose of this EA (MIT LL Facilities Replacement on HAFB Phase 1), it is assumed that heat would be provided by stand-alone boilers within the proposed replacement facility.

With regard to cooling, MIT LL expects to add incremental capacity at its existing Chilled Water Plant (CWP), located on the northern side of the MIT LL campus, between Schilling Circle and Barksdale Street. Another option includes cooling the proposed facility via a "cooling plant", including chillers, primary chilled water pumps, secondary chilled water pumps, condenser water pumps and cooling towers, as summarized below in Table 2.6-1. If cooling is to be provided by

---

[3] With the Upper AFRL now offline and slated for potential demolition, in conjunction with ongoing steam line upgrades by Hanscom AFB, some capacity restrictions have recently been eased.

the MIT LL CWP, MIT LL would add an additional machine to the existing CWP to accommodate the CSL-MIF. It is not anticipated that an increase in footprint of the MIT LL CWP would be required (i.e. MIT LL would upsize units within the existing building). If cooling is to be provided by a cooling plant and associated cooling towers, the location would be evaluated during final site design and the cooling plant would be constructed in accordance with relevant regulations and coordinated with Hanscom AFB.

Table 2.6-1 Heating and Cooling Options for Proposed Replacement Facility

Heating Options	**Description**
HAFB CHP	Current system providing steam heat to existing MIT LL facilities.
Stand-alone Boilers	Low-pressure steam (LPS) and hot water within proposed building
Cooling Options	**Description**
MIT CWP	Increase capacity at MIT LL's existing CWP to supply proposed building
Stand-alone Chillers	Chillers, primary chilled water pumps, secondary chilled water pumps, condenser water pumps, and cooling towers within or nearby the building.

2.7 SUMMARY OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

The following environmental parameters, presented in Table 2.7-1, were identified as having the potential to be affected by one or more of the alternatives for the Proposed Action. The baseline conditions for these parameters are presented in Chapter 3, and the potential effect on these parameters is evaluated in Chapter 4.

Table 2.7-1 Summary of Potential Environmental Consequences

	Preferred Alternative (C/J Lot)	Alternative 2 (J Building)	Alternative 3 (Hillside at Gate 3A)	Alternative 4 (AFRL Open Field)
Topography, Geology, and Soils	0	0	0 / -	0
Land Use	0	- / 0	- / 0	- / -
Water Resources	0	0	0	0
Biological Resources	0	0	- - - / - - -	0
Cultural Resources	0	0	- / 0	- / 0
Air Quality	0 / -	0 / -	0 / -	0 / -
Noise	- / 0	- / 0	- / 0	- / 0
Infrastructure	0	0	0	0

Transportation	- / 0	- / 0	0	0
Solid Wastes	0	- / 0	0	0
Hazardous Materials	0	0	0	0
Socioeconomics	+ / 0	+ / 0	+ / 0	+ / 0
Safety & Health	0 / +	0 / +	0 / +	0 / +
Aesthetics	0	0	0	0

Short Term / Long Term

\+ *positive effect*

0 *no appreciable effect*

\- *minor adverse effect;*

\- - *moderate, but less than significant adverse effect*

\- - - *potentially significant adverse effect*

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

All of the alternative locations proposed for the MIT LL replacement facility are located on HAFB. The existing environmental conditions are described for each alternative in order to provide a baseline against which potential impacts related to construction and operation of the Proposed Action can be determined. General conditions at HAFB and MIT LL are presented for each of the parameters and site-specific detail is included, as available. The following information was obtained from several documents and reports provided by HAFB Civil Engineering and MIT LL Capital Projects Office, as well as subsequent communications with HAFB and MIT LL personnel.

3.2 TOPOGRAPHY, GEOLOGY, AND SOILS

HAFB is located in Middlesex County in the Boston Basin within the Coastal Lowlands region (HAFB, 2010a). The topography in the area of HAFB is characterized by gentle, low lying, easterly slopes. Most of HAFB has an average elevation of 125 to 130 feet above mean sea level (MSL). The MIT LL main campus is located at a somewhat higher elevation, generally ranging from 185 feet to 225 feet MSL. Several low hills are also located in or adjacent to HAFB, including Katahdin Hill (300 feet MSL), upon which the Upper AFRL and adjacent MIT LL property is located.

The primary bedrock formations underlying the base are Siluro-Ordovician intrusive igneous rocks. Andover granite is the most common bedrock underlying the base. Assabet quartz diorite and Shawsheen gneiss are also present in the northeast portion of the base (HAFB, 2010a). Bedrock is exposed at a few locations within the base (HAFB, 2010a). In general, depth to bedrock in the vicinity of the MIT LL campus ranges from as little as 7 feet (in the west) to over 20 feet (in the south and southwest). Surficial geology and geomorphology on the base reflect the presence of several large glaciers during the Pleistocene era, when much of HAFB was covered by Glacial Lake Concord. As the glaciers retreated, eroded bedrock and mixed rock particles were deposited as till, drumlins, kames, and kame terraces (HAFB, 2010a).

Soils at HAFB were generally formed in glacial till/outwash, or ground moraines, with the eastern side (higher elevations) of the base primarily formed in glacial till and the western and northern sides formed in glacial outwash (HAFB, 2010a). Due to earthmoving activities since construction of the base in the early 1940s, most of the soils have been modified and are now urban land or udorthents (HAFB, 2010a). In general, most of the soils at HAFB, especially in the areas with low degree of relief, fall into Hydrologic Soils Group C, indicating a slow rate of water infiltration when soils are thoroughly wetted. However areas with a high degree of relief

fall into Hydrologic Soil Groups B and A, soils with a fast rate of water infiltration (MassDEP, 2003). Areas on base which still maintain the original soil are primarily comprised of sandy loam or loamy sand (HAFB, 2010a).

Subsurface explorations were conducted by GEI Consultants within the Preferred Alternative (C/J Lot) and Alternative 3 (Hillside at Gate 3A) sites in November and December 2012 (GEI Consultants, 2012). Study results are included for both sites below. In addition, the online United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey: Soil Maps-Middlesex County, Massachusetts was consulted for soils located at all sites.

For the **Preferred Alternative (C/J Lot)**, fill soils comprised of fine to coarse sand with silt and gravel are present at the site to a depth of approximately five feet (GEI Consultants, 2012). Glacial till comprised of "very dense soils" with varying amounts of silt and gravel and occasional cobbles and boulders lie beneath the fill. The depth to bedrock ranges across the site from approximately 9 feet to 26 ft below ground surface (bgs). The elevation of the top of bedrock ranges from 176 to 197 ft MSL, with an apparent total relief of 22 ft. The bedrock generally slopes downward from south to north across the site; a bedrock high is located in the south portion of the site (elevation 197) (GEI Consultants, 2012).

As indicated in the USDA NRCS Web Soil Survey, the soils at the Preferred Alternative (C/J Lot) are comprised primarily of Urban Land (map unit symbol 602) (USDA/NRCS, 2011). Urban Land is defined as soils altered or obscured by buildings, industrial areas, paved parking lots, sidewalks, roads, railroad yards, etc. covering at least 75% of surface area (HAFB, 2010a). A small area of Udorthents-Urban Land complex (map unit symbol 656) is located adjacent and parallel to Bestic Drive at this location. Udorthents-Urban Land complex is defined as construction areas where soil has been excavated and/or deposited (HAFB, 2010a).

The ground elevation in the area of the Preferred Alternative (C/J Lot) ranges from 192 ft MSL (near the existing J Building) to 212 ft MSL (near the parking garage).

The soils located at **Alternative 2 (J Building)** are comprised of Urban Land (USDA/NRCS, 2011). The ground elevation in the area of Alternative 2 (J Building) ranges from 178 to 196 ft MSL. Geologic conditions are expected to be similar to those described above for the adjacent C/J Lot.

As indicated in the USDA NRCS Web Soil Survey, the soils located in the area of **Alternative 3 (Hillside at Gate 3A)** have been characterized as Hydrologic Soil Group A, and are comprised primarily of Windsor loamy sand, 3 to 8 percent slopes (map unit symbol 255B); a small portion of the site (near developed areas) is comprised of Urban Land (USDA/NRCS, 2011). Windsor

loamy sand, 3 to 8 percent slopes, is defined as soil formed in sandy glacial outwash, found on glacial outwash plains, terraces, deltas and escarpments (HAFB, 2010a).

However, recent subsurface explorations at Alternative 3 (Hillside at Gate 3A) determined that the silty sand layer, comprised primarily of silty fine sand with varying amounts of gravel, is present only to a depth of approximately 3 feet (GEI Consultants, 2012). Glacial till comprised of "very dense soil" with varying amounts of silt and gravel and occasional cobbles and boulders lies beneath the silty sand soil layer. The depth to bedrock at the site ranges from approximately 36 to 67 ft bgs. The elevation of bedrock ranges from 165 to 215 ft MSL, with an apparent total relief of 50 ft. The bedrock generally slopes downward from south to north across the site (GEI Consultants, 2012). The ground elevation at Alternative 3 (Hillside at Gate 3A) ranges from 230 ft MSL in the vicinity of Schilling Circle to 266 ft MSL in the southwest corner of the site.

The soils located at **Alternative 4 (AFRL Open Field)** consist of Urban Land and Udorthents-Urban Land complex (USDA/NRCS, 2011). The ground elevation in the area of Alternative 4 (AFRL Open Field) is approximately 214 ft MSL.

3.3 LAND USE

HAFB is located approximately 18 miles northwest of Boston, Massachusetts, just outside the Route 128 / I-95 circumferential expressway. The base is located just west of a major light industrial and office park corridor, which leads to the HAFB gate (Hartwell Avenue) closest to MIT LL. HAFB occupies approximately 846 acres of federally-owned land within the Towns of Bedford, Lexington, and Lincoln, all of which are primarily suburban residential communities with commercial centers.

The L.G. Hanscom Field airport (Hanscom Field) is located adjacent to HAFB and partially within the town of Concord to the west; the airport is owned by the Commonwealth of Massachusetts (not HAFB) and administered by the Massachusetts Port Authority (Massport) (HAFB, 2003). The airport is located to the north of the majority of HAFB property. The Air Force uses Hanscom Field occasionally for military flights, comprising less than 1% of the flights from the airport (HAFB, 2003). There are two runways at the airport, approximately 5,000 and 9,000 feet long.

The Minute Man National Historic Park, operated by the National Park Service, is adjacent to the southern perimeter of HAFB, and spans the Towns of Lexington, Lincoln, and Concord, along the Route 2A corridor. The park, encompassing 967 acres, was created by an act of Congress in 1959 to preserve and interpret the events, ideas, significant historic sites, structures, properties, and landscapes associated with the opening of the American Revolution at Concord's North Bridge and along the Battle Road of April 19, 1775.

MIT LL occupies approximately 100 acres on the eastern perimeter of HAFB. The majority of MIT LL's facilities are on federal property, while 20 of the acres utilized are MIT LL property. The MIT LL main campus, as well as the Katahdin Hill facilities, are located within the town boundary of Lexington. The majority of the former AFRL campus is located in Lexington with a small portion located with the town boundary of Lincoln.

MIT LL has several line-of-sight clearance areas for activities including research, testing, and transmission. Proposed projects must not interfere with line-of-sight clearances. Any work performed in clearance areas must be analyzed for proposed impacts; if impacts are anticipated, mitigation measures must be implemented before a project can proceed.

There are 11 major land use classifications distinguishable on HAFB (as identified in the 2003 HAFB General Plan Update) including: Open Space, Aircraft Operation and Maintenance, Industrial, Housing (Accompanied and Unaccompanied), Outdoor Recreation, Research and Development, Medical, Community (Service and Commercial), Airfield (Runway, Taxiway, and Apron), Acquisition Management, and Administrative. The dominant land uses at HAFB are Housing followed by Open Space (HAFB, 2003). The predominant land uses within the MIT LL parcels are Research and Development, Administrative, Industrial, Open Space, and Outdoor Recreation.

The **Preferred Alternative (C/J Lot)** is located to the east of Bestic Drive, in an area currently designated as Research and Development. The site currently serves as a parking lot and small green space for personnel in the nearby facilities. The closest buildings to the site are the existing J Building (1302 J), located immediately north of the site; Building 1302 C, located approximately 75 feet northeast; and Building 1302 A, located approximately 75 feet southeast. The South Lab parking garage is located immediately south of the site, but its vehicle access/egress is located further up the hill, via a driveway extending from Schilling Circle. Nearby land uses include areas designated as Industrial. The site is located within a line-of-sight clearance area for MIT LL research and testing activities.

Alternative 2 (the J Building) is located on the northwest side of the MIT LL campus, to the east of Bestic Drive and south of Schilling Circle (the north part of the circle), in an area currently designated as Research and Development. The site encompasses the existing 75,000 sf J Building (Building 1302 J) (currently being utilized for laboratory space) and the parking lot, which is shared between MIT LL and HAFB and wraps around the existing building. The closest buildings to the site are Building 1305 (General George S Brown Building) on HAFB, located approximately 250 feet north/northwest, and MIT LL's existing research labs, including: Building 1302 F, located approximately 30 feet east/northeast; Building 1302 C, located approximately 30 feet south/southeast; and Building 1302 A, located approximately 170 feet southeast. The South Lab parking garage is located approximately 270 feet south. Nearby land

uses include Administrative and Industrial. The site is located within line-of-sight clearance areas for MIT LL research and testing activities.

Alternative 3 (Hillside at Gate 3A) is located in the Upper AFRL area, to the south of Schilling Circle and southeast of Gate 3A, in an area currently designated as Open Space. The site is heavily wooded and includes a walking path. Building 1141 and 1142 (Former SC Physics Labs) are located approximately 100 ft south and 200 ft southwest of the site, respectively. An MIT LL Equipment Area is located immediately to the south of the site. Nearby land uses include Industrial and Research and Development. The site is located partially within a line-of-sight clearance area for MIT LL research and testing activities.

Alternative 4 (AFRL Open Field) is situated to the southwest of the MIT LL campus, to the south and east of Randolph Road and immediately west of Grenier Street. The western portion of the site is located in the town of Lincoln while the eastern portion of the site is located within the town of Lexington. The site is located within an area designated as Outdoor Recreation and Research and Development and is currently comprised of an open field. The nearest buildings to the site are Building 1105A (399th Combat Support Hospital), located approximately 150 feet south/southeast, Building 1105B (Electronic Research Engineering), located approximately 100 feet south/southwest; and Building 1505 (recently constructed National Guard Joint Forces Headquarters), located approximately 240 feet north. Adjacent land uses include Research and Development and Administrative uses.

3.4 WATER RESOURCES

The characteristics for surface water and groundwater, as well as associated wetlands and floodplains, on HAFB and at MIT LL are discussed in this section and generally describe the conditions in the vicinity of the alternative locations for the replacement facility.

3.4.1 Surface Water

HAFB is primarily located in the Shawsheen River Watershed within the Merrimack River Basin. Prior to construction of the base, the headwaters of the Shawsheen River (a south to north flowing river) originated from a small pond on HAFB that drained northeast through wetlands (HAFB, 2010a). The pond has since been filled, and the headwaters now originate from a swampy area in the southwest portion of the base just north of Folly Pond and North Great Road (MassDEP, 2003). Two unnamed tributaries flow from the swampy area to a culvert at Marrett Street and Old Bedford Road, where the river enters closed conduits (MassDEP, 2003). The river resurfaces to the northeast of the taxiways on HAFB (MassDEP, 2003). The stormwater network conveys surface runoff around HAFB property to the Shawsheen River and Kiln Brook, one of its tributaries (HAFB, 2010a). MIT LL drains to Kiln Brook, and thus contributes to the headwaters of the Shawsheen River (MassDEP, 2003).

The Shawsheen River is a Class B freshwater, as identified under Massachusetts Water Quality Standards and has a designated use of Aquatic Life. However, the headwaters of the Shawsheen River have been assessed by MassDEP as not fully supporting a healthy aquatic community. Based on extensive data and modeling analyses, along with an inventory of potential pollution sources, the section of the Shawsheen River located on HAFB property (Segment MA83-08) is included on the Massachusetts Year 2010 Integrated List of Waters (the 2010 List) as impaired due to pathogens (fecal coliform) and habitat alteration (flooding) (MassDEP, 2010; HAFB, 2010a). As required by the federal Clean Water Act, Section 303d, MassDEP has developed a total maximum daily load (TMDL) for bacteria for the entire length of the river and a draft TMDL for stormwater pollutants for the headwaters (MassDEP, 2002; 2003). A TMDL is essentially a "pollution budget" and a cleanup plan designed to restore the health of an impaired waterbody. During rain events, stormwater pollutants (e.g. sediment as reflected in suspended solids, metals, etc.) enter the headwaters of the Shawsheen River, thus impairing aquatic life uses and impacting river habitat. At the same time, reduction of infiltration to the groundwater system (as a result of the substantial increase of impervious surface accompanying the development of HAFB) diminishes in-stream flow during dry periods, thus stressing aquatic life. The draft stormwater TMDL calls for stormwater and watershed controls, which would mitigate the peaks in runoff from storms through promotion of infiltration of stormwater into the ground. The benefit of the draft stormwater TMDL is expected to be the reduction of peak flows (which contribute to erosion) and an increase in groundwater recharge (which helps maintain in-stream flows during dry periods, thus helping maintain aquatic life).

No surface waters exist within the footprint of the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)**, or **Alternative 4 (AFRL Open Field)**. These areas ultimately drain to the Shawsheen River.

3.4.2 Groundwater

The aquifer located under HAFB flows to the northeast and consists of an upper, unconfined aquifer with lacustrine deposits of glacial origin. The unconfined aquifer is underlain by a semi-confined lower aquifer above bedrock. Groundwater contributes to baseflow of the Shawsheen River, so that river flow is not entirely dependent on rainfall (HAFB, 2010a). Groundwater on the base contains naturally occurring dissolved manganese and iron, which exceeds drinking water standards (groundwater is not used for drinking water) (HAFB, 2003). Additionally, groundwater in some areas has been contaminated due to past activities on base; therefore, the Environmental Restoration Program (ERP) currently monitors and treats several sites for groundwater contamination (HAFB, 2003). The groundwater table within the vicinity of wetlands and areas of lower elevation is known to be particularly high on base (HAFB, 2003). The depth to the water table throughout the base generally ranges from 3 to approximately 23 feet, including the vicinity

of the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)** and **Alternative 4 (AFRL Open Field)** (HAFB, 2003, MIT LL 1988).

Groundwater depth was measured at the Preferred Alternative (C/J Lot) and Alternative 3 (Hillside at Gate 3A) during subsurface explorations conducted by GEI Consultants in November and December 2012 and ranged from 12.9 ft at the Preferred Alternative (C/J Lot) to 23.6 ft at Alternative 3 (Hillside at Gate 3A). Data from a nearby USGS observation well (MA-ACW-158, Acton, MA) with long-term water level records were consulted to determine if the groundwater elevations measured at the site in November/December 2012 were representative of high, low or average conditions. According to the records from that well, water levels in late November/December 2012 were slightly below average.

3.4.3 Wetlands

Prior to construction of the base in the early 1940s, numerous wetlands comprised the land area currently occupied by the base due to the low elevation of the area (MassDEP, 2003). Many of the wetland areas were filled during construction of the base (MassDEP, 2003). Currently, wetlands, ranging from wet meadow to mature forested swamp, occupy approximately 43 acres (five percent) of the base (HAFB, 2010a). A 1997 base-wide wetlands survey (updated in 2007) identified and delineated 35 wetlands on HAFB (HAFB, 2010a).

No mapped wetland areas are located within the footprints of the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)**, or **Alternative 4 (AFRL Open Field)**.

3.4.4 Floodplains

The National Flood Insurance Rate Map (FIRM) indicates that a portion of the Shawsheen River's 100-year floodplain is located in the northeast area of the base, from the headwaters of the river to where it crosses the HAFB boundary. Studies have indicated that a lack of groundwater recharge (due to urbanization/ impervious cover) leads to flooding during storm events and low flow between storm events (MassDEP, 2003; HAFB, 2010a). The base is working with the MassDEP to create best management practices (BMPs), including storm water detention areas, to address the habitat alteration impairment (HAFB, 2010a).

No floodplains are present within the footprints of the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)**, or **Alternative 4 (AFRL Open Field)**.

3.5 BIOLOGICAL RESOURCES

This section contains descriptions of biological resources, including vegetation, wildlife, and threatened or endangered species for HAFB and MIT LL in the vicinity of the alternative locations for the replacement facility.

3.5.1 Vegetation

Due to earthmoving activities since construction of the base in the early 1940s, most of the native vegetation on base has been modified. Undisturbed remnant grasslands comprise less than 5% of uplands on base and occur adjacent to developed areas (HAFB, 2010a). Areas of forested uplands comprise 22% of the base, including mixed hardwood/softwood forests and American beech (*Fagus grandiflora*) stands. Vegetation present on base is representative of species present within the region (HAFB, 2010a). Developed areas of the base are planted with grasses (dominated by rye, fescue, and bluegrass), shrubs and trees for aesthetics and erosion control (HAFB, 2010a). Erosion is minimized on base as part of the maintenance program; plant selection, fertilization, and terracing techniques are used to ensure successful plantings and minimize soil exposure (HAFB, 2010a).

Invasive plants at HAFB include Tartarian honeysuckle (*Lonicera tartarica*), European buckthorn (*Rhamnus frangula*), multiflora rose (*Rosa multiflora*), garlic mustard (*Alliaria officinalis*), purple loosestrife (*Lythrum salicaria*), Oriental bittersweet (*Celastrus orbiculatus*), Japanese knotweed (*Polygonum cuspidatum*), and common reed (*Phragmites communis*). Most of these species are interspersed throughout the upland and wetland systems. These invasive plants are not currently managed at a large scale on base. At a smaller scale, however, work was performed in 2010 to remove the common reed from a stormwater retention area on base; this area continues to be managed. Selected wetland areas may be managed in the future for common reed and purple loosestrife.

Approximately 70 percent of the **Preferred Alternative (C/J Lot)** site is currently parking lot, which is predominantly pavement (and thus devoid of vegetation), although the parking lot includes landscaped islands containing mulch beds, grass, and/or small trees. The remaining 30 percent of the site is a small parcel of approximately 12 to 20 mature trees, primarily eastern white pine (*Pinus strobus*) and oaks (*Quercus* spp.). Vegetation within the understory of this small parcel of mature trees is limited; grass and bare dirt predominate due to mowing and human traffic associated with the picnic benches located within the parcel.

Limited vegetation is present within the footprint of **Alternative 2 (J Building)**. Much of the site consists of the existing building and part of its associated parking lot, and thus is devoid of vegetation. However, the proposed footprint also includes an adjacent mown lawn area with a scattering of small landscaping shrubs and trees.

Alternative 3 (Hillside at Gate 3A) is a mature woodlot, having a density of approximately 200 trees per acre. A tree survey conducted in Fall/Winter 2012 indicated that 11 tree species are present on the hillside, with the following three dominant species: American beech (*Fagus grandifolia*), eastern white pine (*Pinus strobus*), and red oak (*Quercus rubra*) (AECOM, 2013a). There is relatively little vegetation within the understory, as a result of the shading created by the mature canopy.

Alternative 4 (AFRL Open Field) is a semi-routinely mowed field, where vegetation is comprised of grasses (most likely rye, fescue, and/or bluegrass). Two coniferous trees are located near the perimeter of the otherwise open grassy field.

3.5.2 Wildlife

Wildlife occurring or potentially occurring on HAFB and MIT LL include: birds, mammals, amphibians, fish, and macroinvertebrates; however, diversity and abundance are limited on base due to habitat fragmentation. Additionally, the base does not support significant populations of larger mammals, whose movement would be restricted by the base's perimeter fence. HAFB is classified by the Massachusetts Division of Fisheries and Wildlife as a Category II installation (pursuant to AFI 32-7064, *Integrated Natural Resource Management*), defined as installations that "are unsuitable for conserving and managing fish and wildlife because of mission restrictions or resource limitations, or they are of limited size and do not have unimproved grounds" (HAFB, 2010a). HAFB fits this categorization due to the lack of continuous habitat, and the lack of potential management areas for wildlife habitat (HAFB, 2010a). However, HAFB is adjacent to the Great Meadows National Wildlife Refuge. Approximately 85% of the refuge's more than 3,800 acres is comprised of valuable freshwater wetlands stretching along 12 miles of the Concord and Sudbury Rivers. The USFWS protects and manages Great Meadows as nesting, resting, and feeding habitat for wildlife, with special emphasis on migratory birds.

While the fragmented nature of the base habitat has created a favorable environment for avian and small mammal species well adapted to humans and development, there is no noteworthy habitat for wildlife present within the footprints of the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)**, or **Alternative 4 (AFRL Open Field)**.

3.5.3 Threatened and Endangered Species

The Eastern longhorn elderberry beetle (*Desmocerus palliatus*) and the spotted turtle (*Clemmys guttata*) were both previously listed as a state Species of Special Concern but were removed from the protection list in 2006 and are no longer state threatened species. HAFB still takes specific measures to protect the beetle habitat by preserving areas where elderberry bushes (the primary food source) occur. Both species utilize wetlands, and both continue to be inherently protected as part of base wetland protection efforts (HAFB, 2010a).

There are no known federally-listed or proposed threatened or endangered species at HAFB or MIT LL (HAFB, 2010a). There are two state-listed species known to inhabit the grasslands adjacent to the runways on Massport's Hanscom Field: grasshopper sparrow (*Ammodramus svannarum*), listed as threatened, and upland sandpiper (*Bartramia longicauda*), listed as endangered (HAFB, 2010a). Habitat for both species is predominantly grasslands fields (HAFB, 2010a). The MA NHESP has identified portions of HAFB as being within *Priority Habitat* and *Estimated Habitat* for both species (HAFB, 2010a; NHESP, 2008).

The **Preferred Alternative (C/J Lot)** and **Alternative 2 (J Building)** are located within previously developed areas that are primarily paved and/or contain significant infrastructure. **Alternative 3 (Hillside at Gate 3A)** is a forested area dominated by American beech, eastern white pine, and red oak. **Alternative 4 (AFRL Open Field)** is within an open field that offers little habitat due to the nature and frequency of human activity in the vicinity of the field and the semi-routine mowing. None of the alternative locations for the replacement facility are adjacent to the airstrip where known habitat of state-listed species is present. Correspondence with both USFWS and NHESP (see Appendix A) has confirmed that no habitat for rare species is present.

3.6 CULTURAL RESOURCES

The HAFB region contains areas of prominent prehistoric and historic importance. There are hundreds of properties listed in the records of the MHC for the four surrounding towns alone. HAFB is adjacent to the Minute Man National Historic Park (listed on the National Register). In addition, there are other significant places, located within HAFB, which served as naturally fortified positions from which the militia fired on the British. Four prehistoric archaeological sites are located adjacent to the base, and several small prehistoric sites (temporary camps, chipping stations, and lithic workshops) have been reported in the vicinity of the base. However, the 1997 Phase I Archaeological Survey concluded that there are no areas of HAFB that contain prehistoric resources.

3.6.1 Historic Resources

The existing J Building was originally constructed around 1957 as a single-story building without a basement. A single-story addition was added along the western and northern portion of the original building around 1968. A small, single-story addition was constructed at the north-central end of the building around 1978. Around 1982, a single-story addition with a basement was constructed at the north end of the building, wrapping around the 1978 addition. A second floor was constructed on the 1982 addition in 1986. The northwest portion of the building was constructed sometime after 1986 as a single-story addition with a basement (MIT LL, 2008).

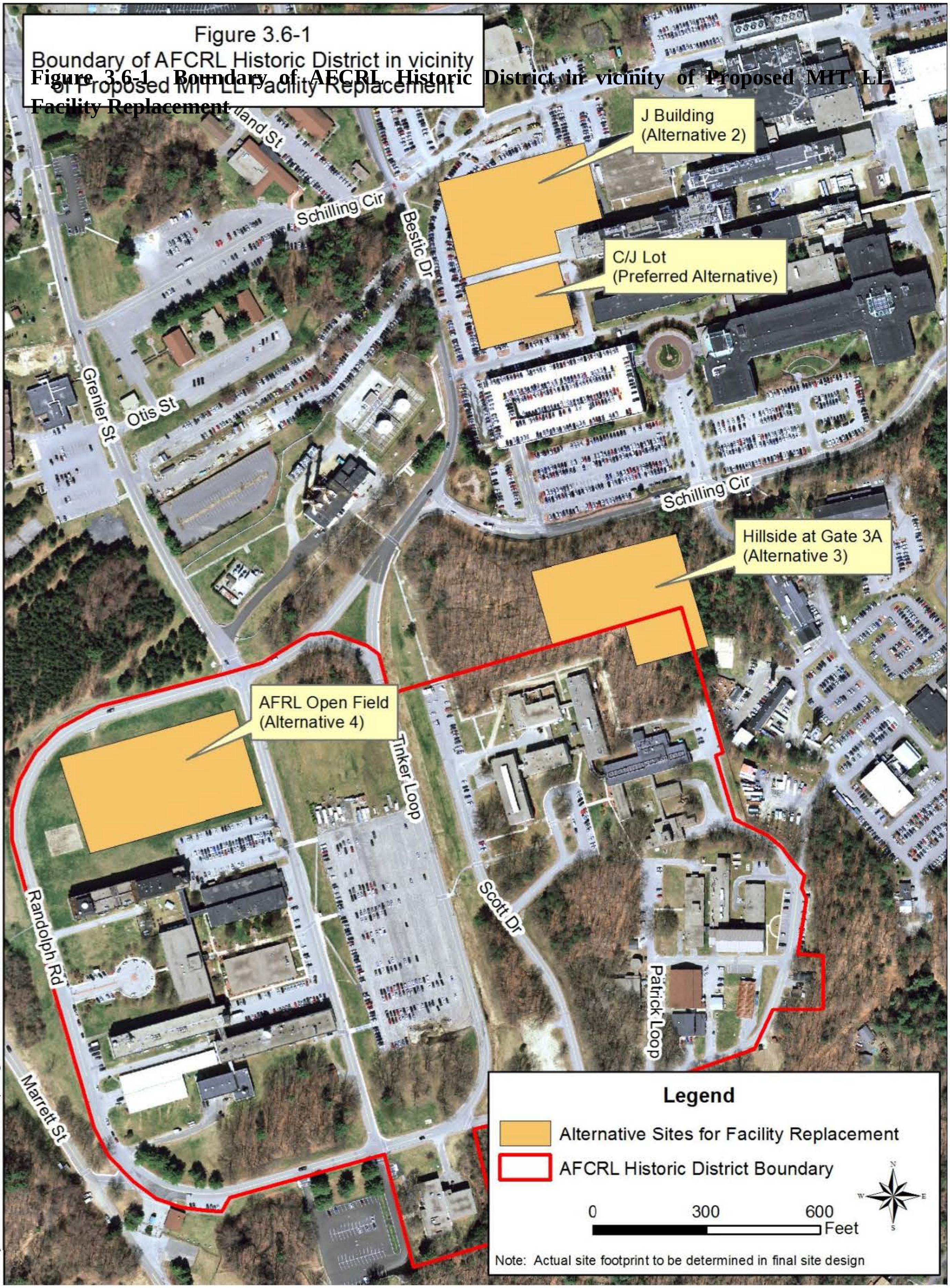
A National Register of Historic Places Eligibility Evaluation was previously conducted at HAFB, as discussed in the *Architectural Building and Inventory Survey* prepared by Public

Archaeology Laboratory in June 2003 (PAL, 2003). The report surveyed and compiled an inventory of the infrastructure that comprises HAFB. The report indicated that the MIT LL complex had undergone extensive alterations throughout the campus. Although building construction dates range from 1952 to 1992, and the existing J Building (Bldg 1302 J) is more than 50 years old, all but one facility (Bldg 1302 F) were determined in the evaluation to be "Not Eligible" for listing in the National Register. As a supplement to the Architectural Building and Inventory Survey, a subsequent report was submitted to the MHC listing the results of a National Register of Historic Places Eligibility Evaluation in May 2010. The existing J Building was again not included in the list of eligible properties (HAFB, 2010b) as it has been remodeled a number of times over the years and thus does not maintain architectural integrity.

The 2010 Eligibility Evaluation identified two districts on HAFB that were considered eligible for listing in the National Register. The two districts were defined as the AFRL Phillips Lab area and the AFRL Katahdin Hill area. In a letter dated June 23, 2011, in response to the proposed demolition of buildings within the AFRL area on HAFB (a separate project proposed by HAFB), MHC suggested a larger district comprised of the two districts and 'possibly together with MIT LL facilities' be considered as meeting the eligibility criteria for the National Register. Subsequently, HAFB, with assistance from their cultural resources consultant, PAL, re-examined the potential historic properties on base, including the AFRL Phillips Lab area, Katahdin Hill, and MIT LL facilities, for their potential unification into a single National Register of Historic Places historic district. In a letter dated January 13, 2012, HAFB responded to MHC indicating that there was justification to establish a single combined Air Force Cambridge Research Laboratories (AFCRL) Historic District to encompass AFRL Katahdin Hill and AFRL Phillips Lab areas. The letter explained that there was not sufficient justification to include the MIT LL-owned portion of the AFRL Katahdin Hill Area in the combined historic district as there are substantial integrity issues due to building alterations and infill construction that would disqualify it for listing in the National Register. Furthermore, the letter included a proposed boundary for the combined AFCRL Historic District (HAFB, 2012a). A response letter from MHC, dated January 17, 2012, indicates concurrence with the combined/revised historic district boundary as submitted by HAFB (MHC, 2012a).

With respect to the combined/revised historic district (AFCRL) boundary, neither the **Preferred Alternative (C/J Lot)** nor **Alternative 2 (J Building)** is located within this district. **Alternative 3 (Hillside at Gate 3A)** is partially within, and partially adjacent to, the historic district. **Alternative 4 (AFRL Open Field)** is located within the AFCRL historic district. See Figure 3.6-1.

Figure 3.6-1 Boundary of AFCRL Historic District in vicinity of Proposed MIT LL Facility Replacement



G:\Projects\MUNI\60216909MIT\Maps\Fig 3.6-1 AFCRL Historic District.mxd

AECOM, on behalf of MIT LL, submitted a project notification form on February 13, 2012 to initiate coordination with MHC relative to MIT LL's proposed action. MHC responded on March 14, 2012 acknowledging that some alternatives would result in new construction within the historic district and that there should be continued consultation, including a review of the proposed design of the new facility. MHC also requested that MIT LL coordinate with a number of potentially interested parties including the historical commissions and boards of selectmen of Bedford, Concord, Lexington, and Lincoln, as well as the Hanscom Area Towns Committee and the Minute Man National Historic Park. Subsequently in June 2012, MIT LL provided the project notification form to these potentially interested parties. MIT LL received one response; i.e., the Lincoln Historical Commission noted that it does not have any direct jurisdiction over the project, but requested that awareness be given to areas of archaeological sensitivity and to historic stone walls (see Appendix A).

3.6.2 Archaeological Resources

A reconnaissance survey for cultural and archaeological resources was conducted on the entire base in 1992 (King et al. 1992) and an intensive survey was conducted in 1998 (Parsons, 1998). The surveys identified 34 areas as having moderate to high potential for archaeological resources. In 2004, in association with creation of the Archeological Sites Record Notebook, the previously defined areas of sensitivity that were tested in 1998 were re-examined, resulting in a new sensitivity map/predictive model for HAFB and the redefinition or elimination of many of the previously identified areas. Thus, there presently are 11 areas of moderate/high sensitivity for archaeological resources thought to occur on HAFB (HAFB, 2010b). The **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, and **Alternative 4 (AFRL Open Field)** are not located within an area identified as having reasonable probability for archaeological resources.

Since **Alternative 3 (Hillside at Gate 3A)** is located within one of the 11 areas identified as having moderate/high sensitivity for archaeological resources, an intensive (locational) archaeological survey was conducted by PAL in November 2012 to more precisely determine the presence/absence of archaeological resources within the potential boundaries of construction. The intensive survey was conducted under Permit #3351 issued by the State Archaeologist and MHC. A total of 99, 50 cm by 50 cm test pits were excavated. A pre-contact period archaeological site (Katahdin Hill Site) was found during the intensive survey marking a small, temporary camp or activity area most likely created by a Native American individual or small group while carrying out specific activities (stone tool making, hunting, collecting forest resources, etc) in the vicinity of Katahdin Hill (PAL, 2013). The site was determined to have low information content; however, and does not represent a potentially significant cultural resource (PAL, 2013). A single historic/modern period ceramic sherd was also found during the intensive survey; however, it was not considered a potentially significant cultural resource (PAL, 2013). No further archaeological investigation of the Alternative 3 (Hillside at Gate 3A) was

recommended following the survey (PAL, 2013); MHC issued a letter on 5 July 2013 indicating their concurrence that no significant archaeological resources are likely to be present.

3.7 AIR QUALITY

The EPA sets National Ambient Air Quality Standards (NAAQS) for criteria pollutants, as required by the Clean Air Act (CAA). Until very recently, Massachusetts had been designated as attainment for all of the criteria pollutants with the exception of ozone. The Commonwealth of Massachusetts, including HAFB and MIT LL, remains designated as a non-attainment area for ozone; however, with several recent changes, or proposed changes, to the NAAQS, Massachusetts is now designated as attainment or unclassifiable for the other criteria pollutants, including carbon monoxide, lead, nitrogen dioxide, particulate matter (including PM_{10} and $PM_{2.5}$), and sulfur dioxide (MassDEP, 2011a), as summarized below.

Carbon Monoxide. Prior to the mid-1980s, Massachusetts was in violation of the CO standards. However, with the adoption of numerous control programs, CO emissions have significantly decreased. The last violation in the state of the CO standards occurred in 1986. Following a request from MassDEP, the EPA, in April 2002, formally designated Massachusetts as being in CO attainment (MassDEP, 2011a).

Lead. In October 2008, EPA lowered the lead standard from 1.5$\mu g/m^3$ to 0.15 $\mu g/m^3$ (averaged over a rolling 3-month period) and established new monitoring requirements. In October 2008, Massachusetts recommended to the EPA that Suffolk County be designated as attainment of the 2008 lead standard based on historic lead monitoring in Boston showing levels below the new standards, and that the remainder of the state be designated unclassifiable (since there were no lead monitors outside of Boston). In January 2011, MassDEP began monitoring lead in additional locations across the state in accordance with the new monitoring requirements (MassDEP, 2011a).

Nitrogen Dioxide. In January 2010, EPA established a new 1-hour NO_2 standard of 100 parts per billion (ppb) and new near-road monitoring requirements began in January 2013. While all eleven existing NO_2 monitors in Massachusetts show levels that meet the new standard, in January 2011, Massachusetts recommended to EPA that the state be designated as unclassifiable with the new standard since near-road NO_2 monitors are not yet in place (MassDEP, 2011a).

Sulfur Dioxide. In June 2010, EPA established a new 1-hour SO_2 standard of 75 ppb and new monitoring requirements beginning January 2013, as well as requirements to model SO_2 emissions from significant sources. While all six SO_2 monitors in Massachusetts show levels that meet the new standard, in June 2011, Massachusetts recommended to EPA that the state be

designated as unclassifiable with the new standard, since modeling of SO_2 emissions from significant sources had not yet been undertaken (MassDEP, 2011a).

Particulate Matter. There are currently two NAAQS particulate matter standards: PM_{10} and $PM_{2.5}$. Massachusetts has been in attainment of the PM10 standard for several years. The $PM_{2.5}$ standards went into effect in 1997 and were revised in 2006. Massachusetts is designated as attainment/unclassifiable for $PM_{2.5}$ standards statewide.

Ozone. For decades, the NAAQS for ozone was based on the maximum 1-hour ozone concentration that occurred each day during the ozone monitoring season. Presently, 1-hour ozone concentrations are still tracked as an indicator, but are no longer used for determining attainment. In 1997, EPA promulgated a new 8-hour ozone standard that was designed to be more representative of exposure over time, rather than just maximum concentration. Massachusetts is designated as non-attainment of this standard. However, ozone monitors currently show that Massachusetts is meeting the 1997 8-hour 0.08 ppm standard. In 2008, the 8-hour standard was revised to 0.075 ppm. In March 2009, Massachusetts recommended to EPA that the entire state be designated as non-attainment with the 2008 standard. The 2008 standard was challenged in court and remanded to EPA. In January 2010, EPA proposed to revise the primary 8-hour ozone standard to a level with the range of 0.060 to 0.070 ppm and proposed a distinct cumulative, seasonal secondary standard with the range of 7-15 ppm-hours (MassDEP, 2011a). EPA was expected to finalize the new ozone standards by the end of July 2011. However, on September 2, 2011, the White House requested that the EPA withdraw the draft ozone NAAQS. Currently, EPA is reviewing the science supporting the ozone standard and this reconsideration is expected to result in a new ozone standard in 2013 (USEPA, 2011). Due to ongoing changes with the regulations, Massachusetts is still designated as non-attainment for ozone.

Since Massachusetts is (currently) designated as non-attainment for ozone, prior to new construction, it must be demonstrated that new construction activities will not contribute to or increase the frequency of NAAQS violations. Ozone results from photochemical reactions in the atmosphere involving precursor pollutants such as VOCs and NO_x. MassDEP, in January 2008, submitted to USEPA a State Implementation Plan (SIP) for attaining the 8-hour NAAQS for ozone. The SIP describes the national, regional and local control measures to be implemented to reduce emissions, and uses air quality modeling and other analyses of air quality and meteorological data to demonstrate that Massachusetts is likely to attain the NAAQS for ozone.

HAFB maintains a Title V Operating Permit, as the base is considered a major stationary source due to its potential to emit NO_x emissions exceeding 50 tons per year; however, MIT LL facilities are not directly included within this permit. Most of MIT LL's existing facilities receive their heating from the HAFB Central Heat Plant, which is regulated as part of HAFB's Title V permit. MIT LL does not currently have a Title V permit, as it does not exceed the thresholds for

being considered a major stationary source. Instead, MIT LL currently has Non-Major Comprehensive Air Plan Approval from MassDEP (permit MBR-08-COM-002 issued September 15, 2008) and a permit for the MIT LL scrubber system. The primary sources of emissions at MIT LL include diesel fuel combustion for standby electrical power and natural gas combustion for heating water. Emissions from laboratory fume hoods are negligible, in part due to the relatively small quantity of chemicals used and due to controls in place to minimize emissions (such as scrubbers in some locations).

MIT LL's Non-Major Comprehensive Air Plan Approval authorizes it to operate a 2,000 kW diesel generator (referred to as Unit No. 1) for emergency power. The Air Plan Approval also establishes maximum allowable facility-wide emission limitations for NO_x, CO, VOC, PM, and SO_2 in tons per month and in tons per rolling 12-month period. The facility-wide emission limitations were established based on thirty-one emergency diesel engines each smaller than 450 kW (totaling 2,985 kW), two emergency diesel engines rated at 500 kW and 800 kW respectively, and nine natural gas boilers each rated below 3 million BTU per hour (totaling 5,643,000 BTU/hour) heat input capacity. Annual reporting of NO_x, CO, VOC, PM, and SO_2 emissions to MassDEP is required. MIT LL operated in compliance with permit emission limits in 2012, the most recent reporting period (MIT LL, 2013b).

3.7.1 Climate Change

Although the Earth's climate naturally changes through time, recent scientific evidence has shown that the process has been exacerbated in the past several decades, most likely due to human activities such as fossil fuel combustion and deforestation. Evidence of a changing climate includes increases in average air temperature and changes in precipitation patterns and storm intensity. This change has been attributed to an excess of greenhouse gases (GHG) in the atmosphere, which absorb solar energy and radiate it back to the Earth surface, rather than radiating solar energy back out of the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons.

3.7.2 Greenhouse Gases

There are a number of state and federal programs regulating GHG emissions. On a national level, the EPA Mandatory Reporting of Greenhouse Gases Rule (40 CFR Part 98) includes GHG emissions reporting requirements for large emissions sources. In Massachusetts, the Climate Protection and Green Economy Act (M.G.L. Chapter 21N) has GHG reporting and compliance requirements outlined in 310 CMR 7.71 (Mandatory Greenhouse Gas Emissions Reporting). Facilities regulated under Title V of the Federal Clean Air Act must report GHG emissions in accordance with both regulations; therefore, HAFB reports GHG emissions, converted into one value known as a CO_2 equivalent (CO_2e), using approved factors to weight each pollutant. The

2008 CO_2e emissions for stationary sources at the base, as reported to EPA and MassDEP, were approximately 41,215 metric tonnes per year (HAFB, 2010e).

3.8 NOISE

The primary source of noise in the vicinity of HAFB and MIT LL results from normal base operation and military and civilian aircraft usage at Hanscom Field. Even though military flights currently comprise just one percent of the flights from Hanscom Field, military flights tend to be noisier aircraft, as military aircraft are exempt from the noise abatement measures applicable to civilian aircraft. In 2010, military aircraft generated 43 percent of Hanscom's total noise energy despite representing slightly less than one percent of the aircraft activity. Military activity has consistently represented less than two percent of the activity during the past two decades, while its contribution to the noise energy has averaged 25 percent and has ranged from 11 percent to 47 percent (Massport, 2011).

Ground-base vehicle operations at HAFB consist mainly of privately-owned vehicles and government vehicles. Government-owned vehicles include on-road maintenance and utility vehicles and off-road equipment such as sweeper vacuums, cranes, lawn lowers, and forklifts (HAFB, 2003). Noise generated independent of aircraft flight at HAFB, such as maintenance and shop operations, ground traffic, and construction, is comparable to the noise generated in the surrounding communities.

The associated noise contours generally reflect proximity to the runways. The area of highest decibel readings (85 dB and higher) is located in the immediate vicinity of the runways. Extended areas of higher level noise occur along the aircraft approach and departure corridors. The MIT LL campus is located a considerable distance from the runways; therefore, aircraft operations do not contribute significantly to existing ambient noise levels.

All of the proposed alternatives for the replacement facility are located within areas that generally have average ambient noise levels of 55 dB or less (Massport, 2011).

3.9 INFRASTRUCTURE

The existing utility services and associated infrastructure at HAFB and MIT LL, in the vicinity of the alternative sites for the replacement facility, are discussed in this section. The utilities include water, wastewater, electricity, telephone, fiber optic, natural gas, and steam and chilled water. Fire protection is also discussed in this section.

3.9.1 Water Supply

Nearly the entire potable water supply to HAFB, as well as MIT LL, is provided by the town of Lexington, through a 10-inch main along Hartwell Avenue and a 12-inch main along Wood

Street. Lexington receives its water from the MWRA, for which the Quabbin Reservoir serves as the primary source. Water is distributed throughout HAFB via 2- to 16-inch diameter lines. Water demand at HAFB has generally shown a decreasing trend since the late 1980s, attributable both to personnel decreases and the implementation of conservation measures. The quantity of water that HAFB can draw from Lexington is limited by contractual agreement to 2 million gallons per day (mgd) (HAFB, 2003). However, HAFB annual water demand rarely exceeds one third of the permitted allocation (HAFB, 2010e).

Water pipelines are located in the vicinity of all the alternatives for the proposed replacement facility. With regard to the **Preferred Alternative (C/J Lot)**, an 8” diameter water distribution line is located parallel to and approximately 140 feet west of Bestic Drive and crosses the footprint of the proposed building. Perpendicular to this line, another water supply line is located parallel to, and immediately north of, the northern boundary of the site. With respect to **Alternative 2 (J Building)**, water lines circumscribe nearly the entire perimeter of the building, with only the northeast portion being devoid of water lines. No water lines are located within the footprint of **Alternative 3 (Hillside at Gate 3A)**; however, a 12” diameter water line is located in Schilling Circle approximately 130 feet north of the northwest corner of the site. An 8” diameter cast iron waterline exists along Randolph Road to the north and west of **Alternative 4 (AFRL Open Field)** and comes within 20 feet of the northwest corner of Alternative 4. A 12” diameter cast iron water pipeline also exists along Grenier Street approximately 30 feet east of Alternative 4.

3.9.2 Wastewater

The wastewater system on HAFB includes two pumping stations, the lower station at Building 1539 (located in the central portion of the base) which collects approximately 75% of the daily flow on base, and the upper station at Building 1306 (located adjacent to the MIT LL campus) which collects the remaining daily flow. HAFB discharges wastewater to the MWRA sewerage system through a 12- to 15-inch force main on Hartwell Avenue. MIT LL has a Sewer Use Discharge Permit issued jointly by the MWRA and the town of Lexington, since MIT LL discharges wastewater to the MWRA sewerage system via the town of Lexington sewerage system. The permit includes self-monitoring, discharge limitations, mandated sampling locations, analysis, reporting/ notification, and other requirements (Permit # 17100088, issued in 2013; expires in 2015).

With regard to the **Preferred Alternative (C/J Lot)**, an 8” diameter vitrified clay (VC) gravity sewer collection pipe, flowing north/northeast to the upper pumping station at Building 1306, is located within the site footprint. Relative to **Alternative 2 (J Building)**, gravity sewer pipelines, flowing north/northeast to the upper pumping station, circumscribe all but the northeast portion of the existing J Building, and the upper pumping station is located approximately 300 feet northeast of the existing J Building. No wastewater lines are located within the footprint of **Alternative 3 (Hillside at Gate 3A)**; however, an 8” diameter gravity sewer collection pipe is present

approximately 170’ to the south. An 8” diameter gravity sewer pipeline, flowing north to the upper pumping station, is located along Grenier Street, approximately 60’ to the east of **Alternative 4 (AFRL Open Field)**.

3.9.3 Storm Drainage

The majority of surface runoff from HAFB enters a subterranean system of eight, 5-foot diameter culverts and ultimately discharges into the Shawsheen River, located along the northeastern boundary of the base. Surface run-off from the eastern portion of the base drains eastward into Kiln Brook, eventually discharging into the Shawsheen River, which flows northeasterly to converge with the Merrimack River in North Andover / south Lawrence. The southern portion of HAFB drains beneath the fenced boundary of the base, under Airport Road, through the Battle Road Unit of Minute Man National Park, and under Route 2A (North Great Road) before ultimately discharging into one of the reservoirs that serves as water supply for the City of Cambridge. There are a number of detention basins on HAFB for the settling and storage of stormwater runoff prior to its entering the storm drain system.

With regard to the **Preferred Alternative (C/J Lot)**, 18” diameter reinforced concrete pipe (RCP) storm drainage lines, flowing north, are located parallel to Bestic Drive and within the footprint of the site; perpendicular and flowing into these lines are other 15” diameter RCP storm drainage pipelines which are also located within the footprint of the site. Relative to **Alternative 2 (J Building)**, storm drainage pipelines circumscribe all but the northern portion of the existing J Building. These pipelines include a 24” diameter RCP, flowing north/northeast, within the western half of the site. An 18” diameter RCP storm drain line, flowing north/northwest and conveying runoff from the Katahdin Hill area, crosses the footprint of **Alternative 3 (Hillside at Gate 3A)** as it conveys flow south to Schilling Circle. There are no storm drainage lines within the footprint of **Alternative 4 (AFRL Open Field)**; however, lines surround the site and include 30” diameter and 18” diameter RCP along Randolph Road to the north and west respectively, an 18” diameter RCP east of the site along Grenier Street, and a 10” diameter RCP servicing the parking lot immediately south of the site.

3.9.4 Electricity

HAFB obtains its power from NStar’s (formerly Boston Edison) Station 320, which is located at Cranberry Hill, approximately one mile southeast of the HAFB boundary. Electrical service is provided at 14.4 kilovolts (kV) through three sets of cables to the base substation (NStar Station 319). Nearly all transmission lines within HAFB are underground. The annual capacity is approximately 151 million kilowatt hours (kWh), roughly twice the recent annual demand (HAFB, 2010e). HAFB has implemented a basewide Energy Management Control System (EMCS), which includes monitoring and control of energy use. For example, the heat temperature is turned down when buildings are vacant (e.g. overnight) and is turned up

approximately one hour before the building becomes occupied (e.g. during regular daytime working hours). More than 85 percent of the office building space on HAFB is connected to the EMCS; smart local controls have been implemented in a portion of the remaining small, stand-alone facilities. Backup and emergency power is supplied by a mix of stationary emergency generators and mobile generators located throughout the base.

MIT LL receives electrical power directly from NStar via a substation separate from HAFB. MIT LL has one large emergency generator capable of producing 2,000 kW, two medium-sized generators (rated at 800 kW and 500 kW), along with 31 medium-sized generators (each engine smaller than 450 kW) adding an additional nearly 3,000 kW of capacity.

With regard to the **Preferred Alternative (C/J Lot)**, a number of electrical lines are located within the footprint of the site. Relative to **Alternative 2 (J Building)**, electrical utility lines circumscribe all but the extreme southeast portion of the existing J Building. No electrical utilities are currently located within the footprint of **Alternative 3 (Hillside at Gate 3A)**, although an electrical distribution line is located beneath Schilling Circle approximately 90 feet to the north. Electric power lines run adjacent to Randolph Road and Grenier Street, approximately 100 feet to the north and 60 feet east of **Alternative 4 (AFRL Open Field)**, respectively; power lines also run parallel (in an east/west direction) to the open field, approximately 100’ south of the site.

3.9.5 Telecommunications

In addition to standard dial-up telephone service, HAFB and MIT LL have a fiber optic backbone that services much of the developed portions of HAFB and the MIT LL campus. Existing telephone and fiber optic lines are located in the vicinity of the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)**, and **Alternative 4 (AFRL Open Field)**.

3.9.6 Natural Gas

Natural gas is supplied to the base by Hess and is distributed by National Grid via an 8-inch high pressure main. Interruptible natural gas is provided to the HAFB CHP for steam and chilled water production. Firm-supply natural gas is distributed to base housing for domestic hot water heaters, gas ranges, and dryers. For FY2007, the total natural gas usage at HAFB was 288,059 million cubic feet (MCF). Annual natural gas capacity is 884,040 MCF. The natural gas distribution system on HAFB currently has capacity limitations due to restrictions on maximum pressure in the lines due to the diameter, age, and/or material of the pipe, as well as limitations at National Grid’s compressor station. However, HAFB and the local utility (Tennaco) are coordinating to increase capacity within the distribution system (HAFB, 2011).

With regard to the **Preferred Alternative (C/J Lot)**, a natural gas line paralleling Bestic Drive crosses the western end of the footprint of the site then makes a 90 degree turn and continues east across the site through the parking lot. Two abandoned natural gas lines are located within the footprint of the existing J Building; however, there is currently no gas service to **Alternative 2 (J Building)**. No natural gas lines are located within the footprint of **Alternative 3 (Hillside at Gate 3A)**; the nearest gas line is located approximately 140 feet south, near Building 1141 in the former AFRL campus. Natural gas lines are not located within the footprint of **Alternative 4 (AFRL Open Field)**; the natural gas line in Grenier Street to the east of the site (which then turns west and crosses the parking lot adjacent to Bldg 1105B) has been abandoned in place. The nearest active natural gas line is located to the northwest of the site, near the National Guard Joint Forces Headquarters Facility (Bldg 1505).

3.9.7 Central Heating (Steam) and Cooling (Chilled Water) Systems

Steam heat is provided by the HAFB CHP to approximately 96 percent of the base (excluding housing), including much of the MIT LL campus, through nearly 40,000 feet of steam lines, which are mostly underground (HAFB, 2003). HAFB is currently upgrading steam supply lines to MIT LL.

Each of the four boilers at the HAFB CHP is rated at 49.15 MMBtu/hr input capacity. HAFB typically only simultaneously operates up to three of these boilers, consistent with USAF policy that recommends one unit be available as standby. However, high demand for heating during severe winter conditions has occasionally required all four boilers to operate simultaneously, up to approximately 80% of the CHP's total rated capacity. HAFB has recently directed additional funding toward operations and maintenance of the CHP, achieving a 5-10% increase in energy efficiency and improving the boiler operation reliability (HAFB, 2011). HAFB has a goal to reduce the overall load on the CHP by strategically disconnecting the most remote buildings (and therefore converting those buildings to de-centralized heat sources). Given the capacity concerns, HAFB does not allow any new buildings to be connected to the CHP without a detailed load study (MIT LL has committed to conducting the load study if connection to the CHP is proposed).

The HAFB CHP also generates chilled water for the base; however, MIT LL has a separate chilled water plant located on HAFB that services the campus.

With regard to the **Preferred Alternative (C/J Lot)**, steam lines and chilled water supply/return lines are located within the footprint of the site. Steam lines and chilled water supply/return lines are also located within the footprint of **Alternative 2 (J Building)**. There are no steam lines or chilled water lines within the footprint of **Alternative 3 (Hillside at Gate 3A)**; the nearest lines are steam lines located approximately 80 feet to the southwest. Steam and chilled water supply/return lines are located within the extreme eastern portion of **Alternative 4 (AFRL Open**

Field); these lines then turn to the west and cross through the small parking lot, continuing to the Conference Center and adjacent buildings.

3.9.8 Fire Protection

The fire station is located on Robins Street in Building 1721, northwest of the MIT LL campus. The HAFB Fire Department performs firefighting and/or rescue for all structures and aircraft, both military and civilian. The Fire Department also performs hazardous material response and stabilization, and confined space rescue. In addition to providing emergency response for all of HAFB facilities, the Fire Department also provides mutual aid for surrounding communities (including Bedford, Lincoln, Lexington, and Concord). More than 20 of the buildings on HAFB have sprinkler systems; the number of buildings with sprinkler systems is increasing as ongoing maintenance and renovation projects are completed.

3.10 TRANSPORTATION

Vehicular traffic enters HAFB and/or MIT LL via one of the following control points:

- Gate 1 (Vandenberg Gate) is accessible from Route 2A, Hanscom Drive, and a segment of Old Bedford Road, and is the main gate for HAFB visitors, commercial vehicles, and some DoD personnel.
- Gate 2, located off Airport Road and Route 2A (near the Lower AFRL), is closed except in the case of emergencies.
- Gate 3 (Wood Street) provides direct access to MIT LL; connects to Hartwell Avenue on the north and to Massachusetts Avenue on the south. Access onto HAFB requires one to also pass through Gate 3A.
    - Gate 3A (Schilling Gate), accessible from Wood Street and Schilling Circle, is located on the boundary between MIT LL and HAFB and serves as the primary access/egress for vehicles traveling between MIT LL and HAFB.

  (Note : Trucks are not permitted to enter through the Wood Street gate)
- Gate 4 (Hartwell Gate), adjacent to and north of the MIT LL campus, is accessed via Hartwell Avenue (becomes Barksdale Street within HAFB) and provides access to Routes 4/225.

Thus, visitors to MIT LL can either access MIT LL directly through Gate 3 (Wood Street), or if they are already within HAFB, then via Gate 3A (Schilling Gate).

The road network on HAFB (and MIT LL) consists of major/minor arterials, collectors, and local streets. The major arterials include:

- Barksdale Street from the Vandenberg Gate to Eglin Street
- Eglin Street from Barksdale Street to Vandenberg Drive
- Vandenberg Drive from Vandenberg Gate to Marrett Street
- Marrett Street from Vandenberg Drive to Barksdale Street

With regard to the **Preferred Alternative (C/J Lot)**, access to the site is via Bestic Drive (from either Barksdale Street or Schilling Circle). **Alternative 2 (J Building)** is located to the east of Bestic Drive and south of Schilling Circle (the north part of the circle) and is also accessible from both roads. Access to **Alternative 3 (Hillside at Gate 3A)** is via Schilling Circle. **Alternative 4 (AFRL Open Field)** is located to the south and east of Randolph Road and immediately west of Grenier Street and is accessible from both streets.

3.10.1 Traffic

Traffic congestion in the vicinity of the base primarily occurs during the peak morning and late afternoon/early evening, as workers arrive and depart via the local and regional highway system. HAFB commuters primarily use Route 2A and Route 4/225 to access Hanscom Drive and Hartwell Avenue to enter the base; both of these state routes interchange with the Route 128/I-95 beltway that rings the Boston area and connects to other radial expressways. These routes are also used by commuters from the area towns, as well as others accessing the many industrial/office parks and commercial businesses in the area.

Almost two-thirds of the morning traffic entering the base uses the two eastern gates (Hartwell and Schilling). Despite having lower traffic counts, Vandenberg Gate still experiences traffic queuing, because visitors and trucks must stop at the gate or the adjacent visitor center for pass clearances (HAFB, 2010e).

A traffic analysis was recently conducted, in conjunction with the development of the Army National Guard Joint Forces Headquarters Facility, which was constructed in 2010-2011, along Grenier Street and Randolph Road [just north of Alternative 4 (AFRL Open Field)]. The existing condition Level of Service (LOS) analysis indicated that all the key signalized and unsignalized intersections experienced significant traffic delays. Each key intersection has one or more approaches operating at a LOS E or LOS F during the morning and afternoon peak hour (HAFB, 2010e). LOS is ranked from A through F, with A representing shorter stopped delays per vehicle, and F representing longer stopped delays per vehicle. By 2014, background traffic volumes are forecasted to increase at the key study area intersections, with the overall LOS from the Route 4/225/Hartwell Avenue declining from a LOS D in 2009 to a LOS E in 2014 for both the morning and afternoon peak hours (HAFB, 2010e).

MIT LL is accessible to Boston via the Massachusetts Bay Transportation Authority (MBTA) public subway/bus system. The MIT LL Travel Office operates a shuttle service between the MIT campus in Cambridge and the main MIT LL campus. The shuttle makes approximately six round trips per workday, with departures staggered every two hours between 7:00am and 5:15pm.

Many MIT LL employees bike to/from work. The Minuteman Bikeway, connecting to the MBTA Alewife Station in Cambridge, provides an easy way for bicyclists, as well as

pedestrians, to travel to subway and bus lines, serving to reduce automobile traffic in the area. The Minuteman Bikeway, which spans approximately 10 miles, is collectively managed and maintained by the four communities it passes through (Bedford, Lexington, Arlington, and Cambridge) and passes close to HAFB where it crosses Hartwell Avenue. In 2011, MIT LL garnered first place awards in the annual MassCommuter Challenge. Over 100 MIT LL employees participated, biking a total of nearly 7,000 miles during Bay State Bike Week, held May 14 to 20. The MIT LL team's mileage earned first place for organizations of 3,000 to 4,999 employees, and it was the highest mileage of all 197 participating organizations, reflecting a strong bike culture within the MIT community. MIT LL has also received awards for outstanding participation and corporate bicycle services, reflecting its ongoing commitment to promoting bicycling as a commuting option and fitness activity (MIT LL, 2011a).

3.10.2 Parking

There is a lack of well-marked, easily accessible parking areas in some areas on HAFB. Although most buildings have a parking lot nearby, parking spaces are not always located in areas coinciding with the highest number of employees. AECOM conducted a comprehensive parking study within MIT LL and adjoining portions of HAFB in October 2012. Seven distinct areas were surveyed, with a total official capacity of 4,097 spaces (AECOM, 2013d). A maximum of 3,290 vehicles were observed during any single two-hour observation period, for an effective parking utilization rate of approximately 80% of official capacity (which occurred between 11 AM and 1 PM). However, five of the seven areas (Parking Garage, South Lab, C/J-FA-Brown, CWP-ML-L, and Katahdin Hill) were observed to be near, at, or over capacity during midday periods, and over 200 vehicles were observed in non-designated or "self-created" spaces (AECOM, 2013d). These latter vehicles often compromised vehicle and pedestrian safety, as well as emergency access, by parking in fire lanes, islands, and circulation aisles. Meanwhile, parking lots to the west of Bestic Drive operated at less than 75% capacity; and the Lower AFRL parking lot reflected utilization less than 20 percent (AECOM, 2013d).

With respect to the **Preferred Alternative (C/J Lot)**, the footprint of the site lies within the parking lot serving primarily C Building and J Building (C/J parking lot); approximately 407 spaces are within this lot, although not all of these spaces are within the footprint of the proposed building; this parking lot is commonly between 85 to 100% utilized.

A portion of the footprint of **Alternative 2 (J Building)** is located within the same C/J parking lot as the Preferred Alternative (C/J Lot). Some employees in the existing J Building utilize the nearby parking garage, which provides over 880 parking spaces. This four-level parking garage frequently operates at 95 to 100% capacity.

Alternative 3 (Hillside at Gate 3A) is across Schilling Circle from the South Lab lot, which includes approximately 450 parking spaces; this parking lot also commonly operates at 95 to 100% capacity.

The nearest parking to **Alternative 4 (AFRL Open Field)** is the small surface lot adjacent to Buildings 1105A and 1105B and the new parking constructed for the Army National Guard Joint Forces Headquarters building.

Both Alternative 3 (Hillside at Gate 3A) and Alternative 4 (AFRL Open Field) are located within a short walk of the Lower AFRL parking lot, which provides approximately 467 spaces and serves the adjacent Conference Center and office buildings along Grenier Street, and provided nearby parking for Upper AFRL when those buildings were occupied. On a typical day, the Lower AFRL parking lot may be utilized 20 percent or less; however, there may be specific events (such as conferences or National Guard training) which result in a short term surge in utilization approaching full capacity.

3.11 SOLID WASTES AND HAZARDOUS MATERIALS

HAFB currently has an Integrated Waste Management Program which includes a Waste Management Plan, a Qualified Recycling Plan, a Pollution Prevention Plan, and a Hazardous Waste Management Plan (HAFB, 2003). The following section describes the use/location of hazardous materials, solid waste management practices, environmental remediation program, and the storage of fuels on HAFB and/or MIT LL.

3.11.1 Hazardous Materials

Hazardous waste generated on HAFB primarily comes from the operation and maintenance activities of the 66 ABW. Hazardous wastes, including adhesives, sealants, greases, waste paint and thinners, solvents, and corrosive cleaning compounds, are accumulated at satellite accumulation points (SAPs) and transferred to the 90-day accumulation site, with final disposal off-base. HAFB has both a Hazardous Waste Management Plan and a Pollution Prevention Plan, targeted at reducing the purchases of industrial toxic substances, eliminating the purchase of ozone depleting chemicals, and reducing the amount of hazardous waste disposed. A component of the Pollution Prevention Plan is the Hazardous Material (HAZMAT) Pharmacy, a centralized operation within base supply that controls the acquisition, temporary storage, use and distribution of HAZMAT.

The Lincoln Laboratory Hazardous Waste Facility Personnel coordinates disposal of all MIT LL facility hazardous wastes**.** The HAFB Hazardous Waste program does not oversee the MIT LL Hazardous Waste program. At MIT LL, the receipt, storage, issuance, procurement, use, and disposal of hazardous materials are in accordance with all applicable laws and regulations. A list

of hazardous chemicals for each work area is compiled and updated annually. When new hazardous chemicals are received, they are added to the list, and chemicals no longer in use for that work area are deleted. The list include the names of the chemical as given on the label and Safety Data Sheets (SDS; formerly Material Safety Data Sheets or MSDS), the manufacturer, the use/storage location, Chemical Abstracts Service Registry Number (CAS#) if assigned, and the planned maximum quantity to be kept in inventory (MIT LL, 2011b). A copy of the annual update is maintained by the Lincoln Laboratory Environmental Health and Safety (EHS) Office.

Annually, Superfund Amendments and Reauthorization Act (SARA) Title III Hazardous Chemical Inventory reporting is conducted for regulated SARA chemicals to meet the requirements of EPA's Emergency Planning and Community Right-to-Know Act. Inventory location and quantity information is updated for the chemicals on this list and submitted to the local fire departments and local emergency planning committees. This inventory is coordinated with the Group EHS and SARA representatives for each lab area by the Laboratory EHS Office. In the future, Toxic Release Inventory (TRI) reporting will be conducted along with SARA Title III reporting. These inventory activities help with emergency pre-planning activities and also assist in identifying possible substitution candidates for less hazardous or non-hazardous chemicals (MIT LL, 2011b).

Purchase requisitions for hazardous chemicals, biological materials, and toxic gases are routed through the Lincoln Laboratory EHS Office for review and approval. Only after the LL EHS Office approves the purchase requisition can the Purchasing group place an order with a vendor/supplier.

There is a single, receiving area (Bldg 1302M) for hazardous materials deliveries. Several trained, qualified, chemical materials technicians receive hazardous materials deliveries from suppliers and coordinate/handle the deliveries to user-laboratories within MIT LL. Delivery procedures and transport containers/carts used to deliver these materials from M-building to user-labs are material-dependent (e.g. Solkatronic vessels would be used for transport of highly toxic gas cylinders, secondary-containment carts would be used for transport of hazardous liquids, etc.).

Gas cylinders, including highly toxic gas cylinders, are tracked throughout the Laboratory via the HazTrack gas cylinder tracking system. Highly toxic gas storage and use areas are monitored by gas detection systems which are interlocked to gas delivery systems, connected to the building/facility emergency evacuation (fire alarm) alarm system, and supervised by the 24/7 Security Dept. Alarm Control Center. Most laboratory flammable gas use/delivery systems are similarly monitored (MIT LL).

Due to the age of facilities at HAFB and MIT LL, asbestos-containing materials (ACM) are

commonly encountered, and estimated to be present in 80 percent of the buildings. Asbestos samples were collected between 2008 and 2010 to determine whether asbestos was present in the basement of the existing J Building (Alternative 2). In 2009, 1 out of 26 samples (pipe insulation) was determined to be asbestos containing materials (2% asbestos); however, there were no asbestos containing materials in the samples collected in 2008 and 2010. Similar to asbestos, the presence of lead based paint is to be presumed in structures on HAFB based on the age of many buildings. Prior to the repainting of the exterior of the J Building, one of the exterior walls (closest to entrance) was analyzed for lead in September 2009 and was found to contain lead concentrations slightly above the residential limit of 1 mg/cm^2 (MIT LL, 2009).

MIT LL has tested for and abated polychlorinated biphenyls (PCBs) in the caulking of Building 1302FA (HAFB, 2010c). It is suspected that other buildings within the MIT LL campus, including the existing **J Building (Alternative 2)**, built during the same time period (1950 to 1979) would also contain the same caulking. Sampling and analysis as part of One Cleanup Program also concluded that PCB contamination was present in some soil samples due to flaking of the caulking material as it aged and began to degrade. However, the report concluded that there was no human health risk, as there was no pathway for exposure as it would be unlikely that anyone would be inhaling, ingesting, or excessively handling the soil in the vicinity of the buildings.

3.11.2 Solid Waste

HAFB has a 100% recycling rate for yard waste and construction and demolition debris (10% composted, 40% fully recycled, and 50% incinerated off base with heat recovery) (HAFB, 2003). Compostable materials (yard waste) are collected by Base Civil Engineering Roads and Grounds Section (HAFB, 2003). All other solid waste is collected by a private contractor and disposed at an off-base incinerator facility within Massachusetts. Approximately 90 tons of solid waste are removed weekly from HAFB (HAFB, 2003).

The HAFB waste management program does not oversee the MIT LL waste management program. Review of recent haul reports indicates that approximately 20 to 25 tons of solid waste (without recyclables) are removed monthly from MIT LL. Recyclables removed from MIT LL during calendar year 2011 included:

- Mixed paper (108 tons)
- Cardboard (96 tons)
- Plastic, glass, and cans (primarily food and beverage containers) (4.6 tons)
- Scrap metal (not including high value metals) (29 tons)
- Wooden pallets (15 loads at 30 cubic yards per load)
- Sand and compostable materials (40 loads)

3.11.3 Environmental Restoration Program

HAFB has historically used, generated, and disposed numerous hazardous substances, including fuel, aromatic solvents, PCBs, and chlorinated solvents. In 1984, environmental studies identified 13 sites, related to past practices at HAFB, warranting further investigation and potential cleanup through the Installation Restoration Program (IRP), now known as the Environmental Restoration Program (ERP). Subsequent discoveries increased the number of sites to 22. Each site was evaluated using the Air Force Hazard Assessment Rating Methodology (HARM), which evaluates potential receptors, waste characteristics, and migration pathways in order to determine the relative potential of uncontrolled hazardous waste disposal facilities to cause health or environmental damage. HARM scores ranged from 86 (high hazard potential) to 6 (small hazard potential). Of the 22 identified potentially contaminated sites, 8 are still active and are either regulated by the US EPA under CERCLA or by the Commonwealth of Massachusetts (HAFB, 2003).

No ERP sites are located within the MIT LL main campus or immediately adjacent to the alternative locations for the proposed replacement facility. However, ERP Sites 10 was a mercury spill at Building 1128, within the Upper AFRL; and ERP Sites 17 / 18 were underground storage tanks (UST) at Buildings 1103 and 1102C (within the Lower AFRL), respectively. Response actions have been completed at all three of these ERP sites (HAFB, 2003).

3.11.4 Stored Fuels

Gasoline, diesel fuel, waste oil, kerosene, propane, #6 fuel oil, and #2 fuel oil are stored in permitted USTs and aboveground storage tanks (ASTs) on HAFB (HAFB, 2003). The only bulk ASTs on base are used to store #6 fuel at the central heat plant (Building 1201) located just west of the MIT LL campus (HAFB, 2003). The primary fuel stored on MIT LL is #2 fuel oil used to supply the campus's emergency generators.

There is one 750 gallon AST for fuel storage for the emergency generator associated with the existing **J Building (Alternative 2)**. The tank is located near the northeast corner of the building.

3.12 SOCIOECONOMIC CONDITIONS

This section addresses the population, employment, general economic condition, and housing on HAFB, MIT LL, and/or the adjacent off-base community. Socioeconomic data specific to the alternative sites for the replacement facility do not exist; however, relevant data for the Commonwealth of Massachusetts, Middlesex County, the Towns of Lexington, Lincoln, and Bedford, HAFB, and MIT LL are presented when available.

3.12.1 Population

The populations of Lexington, Bedford, and Lincoln have increased approximately three to four percent since the 2000 Census (U.S. Census Bureau, 2011). The Towns of Lexington, Bedford and Lincoln all have a lower percentage of persons living below the poverty level as compared to Middlesex County or Massachusetts (Table 3.12-1). Ethnic distribution for the Towns of Bedford and Lincoln differ from the town of Lexington, county, and state averages. The total percentage of minority population for the Towns of Bedford and Lincoln (12.1 and 14.1 percent, respectively) is lower than the town of Lexington, county, and state (20.3, 20.0, and 19.6 percent, respectively; Table 3.12-1).

Table 3.12-1 Income and Ethnicity Statistics for Massachusetts, Middlesex County, the Towns of Lexington, Bedford, and Lincoln, HAFB, and MIT LL[1]

	Massachusetts	Middlesex County	Town of Lexington	Town of Bedford	Town of Lincoln	HAFB	MIT LL
Total Persons	6,547,629	1,503,085	31,394	13,125[2]	8,297[2]	5,828[3]	3,713[4]
Number of Households	2,547,075	580,688	11,537[2]	4,875[2]	2,868[2]	732[3]	0
Percent of Persons Below Poverty Level	10.3	7.4	2.8[2]	4.1[2]	2.1[2]	NA	NA
Land Area (sq mi)	7,840.02	823.46	16.6	13.7	14.4	1.3	0.1
ETHNICITY PERCENTAGES							
White	80.4	80.0	79.7	87.9[2]	85.9[2]	NA	NA
Black	6.6	4.7	0.4	1.4[2]	2.7[2]	NA	NA
American Indian	0.3	0.2	0.1	0.4[2]	0.0[2]	NA	NA
Asia/Pacific Islander	5.3	9.3	17.0	6.9[2]	5.7[2]	NA	NA
Hispanic or Latino[5]	9.6	6.5	2.2	1.5[2]	4.3[2]	NA	NA
Other	---	---	0.6	1.9	1.4	NA	NA
Total Minority[6]	19.6	20.0	20.3	12.1	14.1	NA	NA

NA=Data is not available.
[1] Values based on 2010 U.S. Census data unless otherwise noted (U.S. Census Bureau, 2011).
[2] Values based on U.S. Census Bureau 2005-2009 American Community Survey (ACS) 5-Year Estimates, which were based on data collected between January 2005 and December 2009. The 2010 U.S. Census data were not available for certain categories or for communities smaller than 25,000 people (U.S. Census Bureau, 2011).
[3] Values based on 2012 HAFB Fact Sheet (HAFB, 2012b); total persons based on total workforce and does not include residents not employed by HAFB.
[4] Values based on 2011 MIT LL Annual Report (MIT LL, 2011c).
[5] This category is in combination with one or more of the other races listed.
[6] The percentages may add to more than 100 percent because individuals may report more than one race.

3.12.2 Employment

In 2009, the top employing industry in the Commonwealth of Massachusetts and in the Boston-Cambridge-Quincy, Massachusetts New England City and Town Areas (NECTA), which includes the Towns of Bedford, Lexington, and Lincoln, was education/health services (U.S. Census Bureau, 2011). Professional / scientific / technical services was the top employing industry at HAFB in 2009 (U.S. Census Bureau, 2011).

The workforce at HAFB includes approximately 5,828 military (active-duty and reservists), DoD and non-DOD civilian, and contractor personnel (HAFB, 2012b). The military payroll is approximately $205 million, with an additional $346 million to DoD civilians (HAFB, 2012b). The total regional economic impact of HAFB is estimated to be $6.2 billion (HAFB, 2012b).

MIT LL research expenditures were approximately $855 million in fiscal year 2012 (MIT, 2013). As of 2012, MIT LL employed 3,713 people, including on-site staff technical equivalents, support personnel, technical support, and contractors. Note that "on-site" refers to locations within the HAFB/MIT LL gate, including Katahdin Hill and hangers, but excludes offsite locations such as Westford and Lexington. As of 2012, MIT LL employed 131 technical staff, 54 support personnel, 7 technical support, and 48 subcontractors at the offsite Forbes Road location in Lexington.

Over 40 percent of MIT LL's employees have a doctorate degree, and 32 percent have a Master's degree (MIT LL, 2011c). Employment is relatively uniformly spread among MIT LL's mission areas, with communications and cyber security, space control, missile defense, tactical systems, special projects, and non-DoD areas each comprising 10 percent or more of the work force. The USAF is the largest sponsor of MIT LL employment, representing approximately 36 percent, with smaller portions contributed by the Army, Navy, Department of Homeland Security, FAA, NOAA, NASA, and other governmental agencies (MIT LL, 2011c).

3.12.3 Housing

HAFB's housing was privatized in October 2004 under the authority of the Military Housing Privatization Initiative. The privatized housing includes 732 units in the southwestern portion of base and is available for any active duty personnel with more than three years of service (HAFB, 2012b). Additionally, dormitories are located on HAFB for unaccompanied airmen with less than 3 years of service. There is no housing on the MIT LL campus.

3.12.4 Environmental Justice

Under its instructions for the Environmental Impact Analysis Process (32 CFR Part 989), the Air Force must demonstrate compliance with EO 12898, entitled *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, to determine the effects of federal programs, policies, and activities on minority and low income populations. As

described in Section 3.12.1, the towns where HAFB and MIT LL are located do not appear to have unique populations with respect to poverty or ethnicity. Access to MIT LL facilities is restricted to credentialed professionals (with rare exceptions, such as Take Your Daughter to Work Day). In general, children do not have access to MIT LL facilities.

3.13 SAFETY AND OCCUPATIONAL HEALTH

The MIT LL Environmental, Health & Safety Office is responsible for oversight of EHS issues, and works with the MIT LL technical and administrative staff community to provide technical advice and assistance in maintaining compliance and implementing best practices. To help facilitate this process, MIT LL has implemented the MIT Environmental, Health, and Safety Management System (EHS-MS) to reinforce the commitment to protecting the health and safety of its employees, visitors, and subcontractors, as well as to protecting the environment. The EHS Management System is a structured, organizational approach to environment, health and safety management, designed to drive continual EHS performance improvement. The EHS Management System establishes a set of management tools, principles, processes, and procedures that enable MIT LL to reduce its EHS impact while simultaneously supporting the laboratory's research and development program goals.

The EHS Policy states, in part, that MIT LL is committed to excellence in environmental, health, and safety stewardship locally and globally. Further, the policy states MIT LL's commitment to:

- Minimize adverse environmental, health, and safety impacts of its facilities, activities and operations to protect human health and the environment.
- Achieve and maintain compliance with federal, state, and local environmental, health, and safety regulations and good practices.
- Achieve a high standard of accountability for environmental, health, and safety stewardship.
- Provide educational opportunities to reinforce the values exemplified in this policy.
- Measure and continuously improve environmental, health, and safety performance.

A primary tenet of MIT LL policy is to ensure that the activities conducted, and products and services provided and used, are safe for MIT LL employees, other users, and the general public. This policy also limits the risk of damage to systems or their support equipment and requires a programmed mix of proven policies, practices, and techniques applicable to unique operations.

The MIT LL Environmental, Health, and Safety Office provides environmental and safety support services to the MIT LL community in an array of related areas. Functioning under the Laboratory Safety & Mission Assurance Office (which reports to the Lincoln Laboratory Director's Office), the Environmental, Health, and Safety Office works in collaboration with the MIT campus Environmental, Health, and Safety Office to meet the MIT LL's occupational safety and health program needs and requirements, including compliance with federal (OSHA), state, local, and

applicable USAF regulations. Program areas of focus include general industrial safety (electrical safety, mechanical safety, fire safety, life safety, working at heights, etc.) chemical safety/industrial hygiene, ionizing and non-ionizing radiation safety, biosafety, emergency preparedness, and workplace ergonomics.

All new MIT LL employees and resident subcontractors must attend an initial Safety (EHS) Orientation class. All individuals who engage in or oversee activities (work with potentially hazardous materials, equipment, or processes) that are regulated because of potential risks to the environment, health, or safety must receive training appropriate to the regulated activity. MIT LL policy requires that operational instruction of personnel include safety instruction. Instruction on the potential hazards inherent in any operation must be made part of the operations instruction program. Responsibility for ensuring personnel training resides with Group Supervisors. All MIT LL personnel performing critical tasks or controlling critical processes or potentially hazardous operations during manufacturing test, checkout, servicing, and flight training operations are trained and certified as applicable.

MIT LL provides information and training to employees on the hazards associated in their workplace and notifies employees when new hazards are introduced into their work area. Training includes methods and observations that may be used to detect the presence or release of a hazardous material in the work area (i.e., visual appearance, monitoring, and odor). Employees are informed of the location of chemical hazards in their work area, the physical and health hazards of the materials, routes of exposure and exposure limits, and the location and availability of the written hazard communication program, including the required lists of hazardous materials and SDSs. Employees are made aware of the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and/or the OSHA Laboratory Standard (29 CFR 1910.1450) as required. Employees are given an explanation to the approach for identifying hazardous materials (when shippers or other containers are subdivided, etc.), a general review of the information contained on an SDS and how to interpret the information, a general overview of how to read labels and review an SDS to obtain the appropriate hazard information. MIT LL personnel are trained in the methods for safe handling and use of hazardous materials.

Safety is an integral part of every group, division, and department within the MIT LL organization. Routine group meetings, combined with written safety notices and information from the Lincoln Laboratory Environmental, Health, and Safety Office, constitute the primary communication path to and from all personnel. MIT LL personnel are responsible for complying with the EHS requirements, as well as federal, state, local and applicable USAF regulations, and are required to perform assigned tasks in a manner that ensures safety for themselves and their fellow workers.

Operating procedures and work rules specify the dress codes and personal protective equipment requirements. It is the responsibility of the project manager and/or supervisor to ensure that required equipment is available and used. Additional checks as necessary confirm that these requirements are enforced. In addition, equipment and hardware systems may be outfitted with interlocks, machine guards and other protective safety devices. Removal or nonuse of these safety guards and devices is prohibited unless authorized by the project manager with the concurrence of a Safety representative and a written work procedure is prepared and followed.

Spaces with toxic gases or high hazard chemicals are controlled-access spaces. Access control may utilize ID-badge proximity readers, electronic keypad, cipher-lock, or key-lock to control access. Spaces with acutely toxic gases and other highly hazardous materials are locked at all times. Other chemical areas may be unlocked whenever the area is occupied.

3.14 AESTHETICS

Features such as runways, aircraft hangars, lights, antennae, and towers in the vicinity of Hanscom Field impart a functional aesthetic quality on the base; these aesthetic qualities are considered to be an integral part of the HAFB landscape. These basic features and airfield-related activities give the impression of an organized and functional military installation. HAFB has policies, including Architectural Compatibility Standards, regarding the aesthetic appearance and architectural compatibility of the grounds and buildings (HAFB, 2003).

Relative to the **Preferred Alternative (C/J Lot)**, the site is not visible from off-base, but is visible from adjacent buildings and roadways within the MIT LL campus and portions of HAFB. Representative views of the site are provided in Figure 3.14-1. In this figure, View 1A (facing north) shows the parking area and landscaped area as viewed from the parking garage, with the existing J Building shown in the background. To the west (not shown in the photo) is Bestic Drive providing access to the site. View 1B shows the four-level parking garage located south of the site.

Alternative 2 (J Building) is also located on the west side of the MIT LL campus. The site includes the existing J Building and the area outside of the building footprint. Representative views across the site are provided in Figure 3.14-2. In this figure, View 2A (facing southwest) shows the view of the existing J Building from Schilling Circle. View 2B (facing northeast) shows the view of the J Building from Bestic Drive. This site is not visible from off-base, but is visible from adjacent buildings and roadways within the MIT LL campus and portions of HAFB.

Representative views across **Alternative 3 (Hillside at Gate 3A)** are provided in Figure 3.14-3. The site is within an existing forested hillside containing a walking path/fitness trail and recreational facilities (a picnic pavilion and volleyball court) (View 3A). View 3B is taken facing south toward the site. The photograph shows the parking area and Schilling Circle in the foreground. Not shown in the figure, the Health and Wellness Center is located to the east of the site and MIT LL's Katahdin Hill research and development facilities are located to the southeast.

Figure 3.14-1 Photographs Taken in August 2011 at the Location of the Preferred Alternative (C/J Lot)

View 1A (above). Facing north across the site.

View 1B (above). Facing south across the site.

Figure 3.14-2 Photographs Taken in August 2011 at the Location of Alternative 2 (J Building)

View 2A (above). Facing southwest toward the location of the existing J Building.

View 2B (above). Facing northeast toward the location of the existing J Building.

Figure 3.14-3 Photographs Taken in October 2011 at the Location of Alternative 3 (Hillside at Gate 3A)

View 3A (above). View of the walking path/fitness trail and recreational facilities (picnic pavilion and volleyball court) located in the southeast portion of the site.

View 3B (above). Facing south towards the forested hillside located beyond the parking area.

Figure 3.14-4 Photographs Taken in October 2011 at the Location of Alternative 4 (AFRL Open Field)

View 4A (above). Facing east across the site.

View 4B (above). Facing north across the site.

Alternative 4 (AFRL Open Field) is comprised primarily of mowed field. This site also is located on one of the higher plateaus within HAFB; it is not visible from off-base or the main MIT LL campus, but is visible from the Upper AFRL Katahdin Hill facilities. Representative views across the site are provided in Figure 3.14-4. In this figure, View 4A (facing east) shows the existing building (Building 1105B) adjacent to the site to the south. View 4B (facing north) shows the access road and the Army National Guard Joint Forces Headquarters facility being constructed in the background.

4.0 SUMMARY OF ANTICIPATED ENVIRONMENTAL IMPACTS

4.1 INTRODUCTION

The No Action alternative would require continued occupancy within over-crowded and outdated facilities on the MIT LL main campus. While the No Action alternative presumes significant investment for ongoing and deferred maintenance of the aging buildings, there would be no inherent functional improvements to support MIT LL's mission of state-of-the-art research; consequently, this is not a viable alternative.

The Proposed Action would involve the construction of a 145,000 to 175,000 sf, depending on the site selected, replacement facility on HAFB. There are four alternatives to accomplish the Proposed Action, including the **Preferred Alternative (C/J Lot)**, **Alternative 2 (J Building)**, **Alternative 3 (Hillside at Gate 3A)**, and **Alternative 4 (AFRL Open Field)**. Alternative 2 (J Building) includes the demolition of the J Building (to make space for the new building); no structural demolition is required to accomplish the Proposed Action or any of the alternatives other than Alternative 2 (J Building).

The No Action alternative would not result in alteration of the natural or human environment at MIT LL or HAFB, as explained in the sections which follow. The Proposed Action may result in potential impacts to the natural or human environment as a result of construction (short-term) and/or operation (long-term) of the replacement facility. These potential impacts are described by environmental parameter in the sections which follow. The following sections are organized for each environmental parameter by impacts common to all build alternatives in a "Common Effects" section, followed by specific discussions for alternatives where additional impacts are anticipated.

4.2 TOPOGRAPHY, GEOLOGY, AND SOILS

4.2.1 Common Effects

Construction of the replacement facility would require soil disturbance at any of the alternative sites. Excavation would be necessary to construct the foundations for the new building, to facilitate site landscaping, and to install stormwater management controls. Connection of the proposed building to nearby existing utilities would also require excavation, as would the relocation of existing utilities around the footprint of the proposed building. While construction activities associated with the proposed building would alter the soils at any of the alternative sites, the work would proceed in accordance with HAFB BMPs for stabilizing soils and minimizing erosion.

4.2.2 No Action

The No Action alternative would not result in any short or long term impacts to topography, geologic features, or soils on HAFB or the MIT LL campus.

4.2.3 Preferred Alternative (C/J Lot)

The construction activities for the proposed facility at the Preferred Alternative (C/J Lot) are not anticipated to impact topography, as the location is a relatively level site that was previously developed for a parking area. The parking area, comprised primarily of asphalt, would need to be removed prior to construction of the replacement facility.

Given the proximity of existing buildings, including laboratory equipment sensitive to vibration, the intent is to avoid generating a lot of vibration inducing construction methods. However, due to the potential presence of shallow bedrock (i.e. 9 to 26 feet below ground surface), some rock-drilling and/or limited blasting may be required during construction, depending on the type of foundation selected for the replacement facility.

Operation of the proposed facility at the Preferred Alternative (C/J Lot) is not anticipated to result in long term impacts to geology or soils at the proposed location.

4.2.4 Alternative 2 (J Building)

Construction of the replacement facility at the J Building is not anticipated to impact topography, as the location is a relatively level site that was previously altered during the construction of the existing J Building and adjacent parking area. The existing J Building would be demolished prior to construction of the replacement facility.

Given the proximity of existing buildings, including laboratory equipment sensitive to vibration, the intent is to avoid generating a lot of vibration inducing construction methods. However, due to the potential presence of shallow bedrock, some rock-drilling and/or limited blasting may be required during construction, depending on the type of foundation selected for the replacement facility.

Long term impacts to topography, geology, or soils are not anticipated as a result of Alternative 2 (J Building).

4.2.5 Alternative 3 (Hillside at Gate 3A)

Soils in the vicinity of Alternative 3 (Hillside at Gate 3A) are Windsor loamy sand and would likely be re-characterized as Urban land following construction of the replacement facility, consistent with the majority of soils on HAFB. Construction of the replacement facility at this location would negatively affect this soil type, since the site has not previously been developed.

Excavation is not anticipated to reach the depth of bedrock, which ranges from 36 to 67 feet below ground surface at the site. However, some rock removal is anticipated, including a number of large boulders strewn across the hillside.

The presence of the proposed building at Alternative 3 (Hillside at Gate 3A) may result in a long-term change in topography, following final site grading, installation of stormwater management controls, and construction of retaining walls, if necessary.

4.2.6 Alternative 4 (AFRL Open Field)

Construction of the proposed replacement facility at Alternative 4 (AFRL Open Field) is not anticipated to impact topography, as the location is a relatively level site.

Given the proximity of existing buildings, the intent is to avoid generating a lot of vibration inducing construction methods. However, due to the potential presence of shallow bedrock, some rock-drilling and/or limited blasting may be required during construction, depending on the type of foundation selected for the replacement facility.

Long term impacts to topography, geology, or soils are not anticipated as a result of Alternative 4 (AFRL Open Field).

4.3 LAND USE

4.3.1 Common Effects

Short-term impacts associated with construction, regardless of location selected, would be anticipated to include temporary disruption of adjacent land uses due to elevated noise levels, increased dust, interference with roadway access, and visual impacts.

4.3.2 No Action

The No Action alternative would result in the continued occupancy of the aging, over-crowded facilities on the MIT LL main campus. As there would be no new construction, there would be no change in designated land uses.

4.3.3 Preferred Alternative (C/J Lot)

Notification of the proposed construction at the Preferred Alternative (C/J Lot) must be provided to FAA, as the proposed building would penetrate the imaginary surface extending at a slope of 100 to 1 for a horizontal distance of 20,000 feet from the nearest runway.

The proposed facility at the Preferred Alternative (C/J Lot) would be compatible with the existing land use designation of Research and Development as well as the adjacent land designated for Industrial purposes. The site for the Preferred Alternative (C/J Lot) is currently used as a parking area and includes some green space, both of which would be displaced by the proposed replacement facility. Construction would result in the permanent displacement of approximately 205 existing parking spaces near the existing J Building; however, sufficient parking spaces would still exist within the overall study area to satisfy demand (i.e. it is anticipated that a higher number of vehicles would park in the Lower AFRL and Bestic areas, where surplus capacity more than offsets the numbers of parking spaces lost to construction of the replacement facility; see Section 4.10.3 for additional discussion). Additionally, signage could be provided in some of the remaining spaces in the C/J Lot to allow for dedicated spaces for Building 1305 (Brown Building), as this is an HAFB customer service facility which includes retiree services. While some green space would be lost to the building footprint, it is anticipated that this can be partially restored in the landscaped buffer than would be created to circumscribe the new building.

While a portion of the Preferred Alternative (C/J Lot) may fall within the Line of Sight (LOS) angle for laser/communication equipment originating within either the MIT LL main campus (e.g. Bldgs 1302B/1302C) or its Katahdin Hill facilities, it is expected that any potential LOS conflicts can be satisfactorily managed, with one option being to relocate[4] the laser/communication equipment, potentially into the proposed replacement facility. Given a ground elevation that ranges from 192 to 212 feet MSL, the proposed multi-story building (approximately 50 feet high) would not violate the horizontal surface (283 feet MSL) established for minimizing obstructions within navigable airspace at Hanscom Field; therefore, no waiver from Federal Aviation Regulation (FAR) Part 77 would be required.

4.3.4 Alternative 2 (J Building)

Prior to the demolition of the J Building (currently housing the Electronics Research Laboratory) and subsequent construction of the replacement facility, the current office and laboratory functions within J Building would need to be temporarily or permanently relocated to other areas on the MIT LL campus, HAFB, or off base. Notification of the proposed demolition and construction would be provided to FAA, as cranes and other construction equipment associated with the proposed replacement facility would penetrate the imaginary surface which extends at a slope of 100 to 1 for a horizontal distance of 20,000 feet from the nearest runway.

There are no long-term impacts anticipated for the replacement facility at Alternative 2 (J Building). The proposed replacement facility would be consistent with the existing land use

[4] Typical LOS activities revolve around short-term temporarily mounted equipment on the roofs of existing buildings. If needed, this equipment can be relocated to other roofs within the MIT LL campus or simply to a different location on the current roof.

designation of Research and Development. While a portion of the proposed replacement facility may fall within the LOS angle for laser/communication equipment originating within either the MIT LL main campus (e.g. Bldgs 1302B/1302C) or its Katahdin Hill facilities, it is expected that any potential LOS conflicts can be satisfactorily managed. The footprint of the proposed replacement facility is larger than the J Building and thus also encompasses part of the parking area around J Building. Additionally, J Building was constructed prior to the implementation of UFC establishing setbacks between parking areas and buildings; thus, little/no space would remain within the site to re-establish parking spaces. Given a ground elevation that ranges between 178 and 196 feet MSL, the proposed 4 story building (approximately 65 feet high) would not violate the horizontal surface (283 feet MSL); therefore no waiver from FAR Part 77 would be required.

4.3.5 Alternative 3 (Hillside at Gate 3A)

The location of Alternative 3 (Hillside at Gate 3A) within an area designated as Open Space would result in a change in land use to Research and Development, consistent with the adjoining parcels of the MIT LL campus. The land use change would occur upon approval from the Facilities Utilization Board (FUB; a board that evaluates requests for real estate, use of existing facilities, inter-Service support, and construction to ensure compliance with Joint Civil-Military Engineering Board priorities). A portion of the wooded area would not be disturbed and would remain as open space and a visual buffer. The existing walking trail would be re-routed around the proposed replacement facility to connect the remaining wooded area with the existing recreational facilities (e.g. the picnic pavilion and volleyball court). To minimize the amount of open space disturbed, no parking is proposed on the site of Alternative 3 (Hillside at Gate 3A). Parking capacity would be provided by the existing MIT LL garage (where many of the employees to be relocated into the replacement facility at this site currently park) and/or the Lower AFRL parking lot.

A portion of Alternative 3 (Hillside at Gate 3A) may fall within the LOS angle for laser/communication equipment originating within the MIT LL Katahdin Hill facilities; however, it is expected that any potential LOS conflicts can be satisfactorily managed. Given a ground elevation that varies from 230 to 266 feet MSL, the proposed multi-story building (approximately 65 feet high) would penetrate the horizontal surface (283 feet MSL) established for minimizing obstructions within navigable airspace at Hanscom Field. Thus, MIT LL would seek a waiver from FAR Part 77. Numerous buildings on the higher elevations of HAFB, particularly within the Upper AFRL have similar waivers. Additionally, the ground surface alone in parts of the Upper AFRL (where ground elevations range from 272 to 304 MSL) already penetrates the horizontal surface, without even considering the height of buildings/structures in this area.

MIT LL is currently coordinating with the Life Cycle Management Center (LCMC), formerly known as the Electronics System Center (ESC), at HAFB to determine whether any transmission

activity still occurs in the vicinity of the Scott Road parking lot (just to the southwest of the Hillside at Gate 3A). If LCMC still retains a periodic mission requirement for such transmission activity, it is anticipated that any potential conflicts can be satisfactorily managed.

4.3.6 Alternative 4 (AFRL Open Field)

Notification of the proposed construction at Alternative 4 must be provided to FAA, as the proposed replacement facility would penetrate the imaginary surface extending at a slope of 100 to 1 for a horizontal distance of 20,000 feet from the nearest runway.

The location of the replacement facility within an area designated for Outdoor Recreation would result in a change in land use to Research and Development, consistent with adjoining parcels within the AFRL. The land use change would occur upon approval from the FUB. The footprint of the proposed replacement facility would permanently displace the existing use as an open field.

Given a ground elevation ranging from 208 to 220 feet MSL, a waiver from the horizontal surface (283 feet MSL), as established by FAR Part 77, would not be required unless the building were to exceed a height of approximately 65 feet.

4.4 WATER RESOURCES

4.4.1 Common Effects

There are no surface water features, wetland resources, or floodplains present within the footprint of any of the alternative sites. Therefore, it is not anticipated that construction activities would directly affect these resources. However, since the project would require surface disturbance and there would be periods of bare soil exposed, the potential exists for the ground to erode and be carried into the stormwater system. During construction, all activities would be conducted in accordance with best management practices to prevent adverse effects to the receiving water (i.e. Shawsheen River) into which the stormwater system discharges. Since the construction would result in the disturbance of greater than one acre, MIT LL would obtain and comply with the NPDES General Permit for Stormwater Discharges from Construction Activities. Construction of the replacement facility would have the potential to intersect the groundwater table due to seasonally high groundwater levels throughout the base. Therefore, dewatering may be necessary, and the construction contractor would be required to include provisions for dewatering. It is anticipated that the excess groundwater within the construction site would be pumped to an upland location and, if necessary, conveyed to a stilling basin (to remove suspended solids) and/or energy dissipating device, then allowed to flow overland and re-infiltrate the ground.

Federal agencies are required to comply with Section 438 (*Storm water runoff requirements for Federal development projects*) of the *Energy Independence and Security Act of 2007* (H.R. 6) in order to protect water resources at federal project sites that exceed 5,000 sf (0.1 acres) (USEPA, 2009). Agencies must maintain or restore pre-development hydrology by using stormwater management practices, such as reducing impervious surfaces. In order to comply with Section 438, rainfall must be managed on-site to the extent possible, and off-site discharge of stormwater from all rainfall events less than or equal to the 95th percentile rainfall event must be prevented. The 95th percentile rainfall event is the event whose precipitation total is greater than or equal to 95 percent of all storm events over a given period of record; it is location specific and must be calculated and documented to remain in compliance (USEPA, 2009).

Additionally, HAFB stormwater policy places a similar emphasis on maximizing on-site recharge and reducing impervious cover to the extent practicable. As the proposed replacement facility is still in the conceptual design phase, the stormwater management design has not yet been determined; however, the potential structural BMPs include a green roof, subsurface infiltration systems, or retention (infiltration) basins. For alternatives in which no parking would be created around the site, the run-off to be captured by the stormwater system would be primarily roof runoff and therefore contain relatively low concentrations of suspended solids or bacteria, compared to typical urban runoff.

As noted previously, MassDEP has issued a TMDL for the entire length of the Shawsheen River for bacteria and a draft TMDL for the headwaters of the river for stormwater. Therefore, the design of the replacement facilities would be consistent with the Shawsheen River TMDLs and comply with the stormwater runoff requirements of Section 438 of the Energy Independence and Security Act of 2007. It is expected that MIT LL's design of the replacement facility, regardless of the alternative selected, would implement stormwater structural BMPs to reduce runoff during wet weather events and retain or infiltrate water on-site (or nearby) in accordance with HAFB's drainage requirements.

4.4.2 No Action

The No Action alternative would not result in any alteration of the surface water, groundwater, wetland, or floodplain resources on MIT LL or HAFB.

4.4.3 Preferred Alternative (C/J Lot)

As part of the initial design of the replacement facility, soil borings were conducted during the subsurface explorations conducted by GEI Consultants at the Preferred Alternative (C/J Lot) in November and December 2012 to precisely determine/confirm the soil types and the associated rate of infiltration that occurs on the site. Results of the borings indicated fill to a depth of 5 feet; glacial till consisting of "very dense soil" was encountered beneath the fill. Due to the low

permeability of the existing soils, it is not anticipated that it would be difficult to maintain or restore pre-development hydrology.

No long-term impacts to the surface water, groundwater, wetlands, or floodplains are anticipated to result from the operation of replacement facility. The footprint of the Preferred Alternative (C/J Lot) lies within a parcel that is approximately 70% impervious surface due to the existing parking lot; it is expected that the site would have a similar impervious/pervious ratio following redevelopment, as the replacement facility would include a landscaped buffer around the perimeter of the building.

4.4.4 Alternative 2 (J Building)

No long-term impacts to the surface water, groundwater, wetlands, or floodplains are anticipated to result from the operation of replacement facility. The footprint of the proposed replacement facility lies within a parcel that is approximately 80% impervious surface, due to the presence of the existing J Building and adjacent parking lot. It is expected that the site would have a similar impervious/pervious ratio following redevelopment, as the replacement facility would include a landscaped buffer around the perimeter of the building.

4.4.5 Alternative 3 (Hillside at Gate 3A)

The footprint of Alternative 3 (Hillside at Gate 3A) lies within an undeveloped hillside, and would result in an increase of approximately 2.3 acres of impervious surface within the Shawsheen River Watershed.

As part of the conceptual design of the replacement facility, soil borings were conducted during the subsurface explorations by GEI Consultants in November and December 2012 to precisely determine/confirm the soil types and the associated rate of infiltration that occurs on the site. Results of the borings indicated sand (highly permeable) to a depth of three feet; however, glacial till consisting of “very dense soil” was encountered beneath the fill. Thus, the geotechnical investigation concluded that groundwater recharge rates on the hillside are less than would otherwise be suggested, since the highly permeable upper soil layer is so shallow (just 3 feet deep) and overlays dense soil with low permeability.

Recognizing that use of this site could be challenging with regard to compliance with HAFB stormwater policy that places an emphasis on maximizing on-site recharge and reducing impervious cover to the extent practicable, AECOM conducted a stormwater evaluation and proof of concept study (AECOM, 2013b). The conceptual stormwater management plan began with the development of an existing conditions map, incorporating features such as land use, soil type, topography, and existing site storm drainage. Once the existing site conditions were established, the project area was delineated indicating the direction of stormwater flow. A

stormwater model was then developed to estimate the peak stormwater runoff rates under existing conditions during the 2-, 10-, and 100-year 24-hour storm events. Then, potential BMPs were grouped into treatment trains, each designed to manage stormwater runoff from a portion of the site upon development. The stormwater model was then re-run, to reflect the proposed post-construction conditions, and allowing for the calculation of post-construction peak stormwater runoff rates, which were then compared to the pre-development (i.e. existing condition) rates. The study concluded that it would be feasible to manage stormwater on-site, such that there would be no increase in peak runoff from the proposed replacement facility for the 95th percentile, 2-, 10-, and 100-year storms (AECOM, 2013b).

4.4.6 Alternative 4 (AFRL Open Field)

The footprint of the proposed replacement facility lies within an undeveloped open field, and would result in an increase of approximately 2.9 acres of impervious surface within the Shawsheen River Watershed. As described for Alternative 3 (Hillside at Gate 3A), the associated increase in impervious surface would require a more extensive stormwater management system to capture and infiltrate the run-off, such that the rate of groundwater recharge post-construction exceeds that which occurs presently on the open field.

If an on-site parking lot is included in the final design at Alternative 4 (AFRL Open Field), the stormwater management system would likely include oil/water separators to address the potentially higher pollutant loads associated with parking lots.

4.5 BIOLOGICAL RESOURCES

4.5.1 Common Effects

Construction of the replacement facility, regardless of the alternative, would require grading and excavation that would result in the loss of existing vegetation. However, once the proposed building superstructure is in place, a landscaped buffer would be created around the perimeter of the building, thereby establishing an approximately 80-foot wide green space with grass, shrubs, and small trees around the building, and somewhat offsetting the vegetation lost during construction.

Operation of the replacement facility is not expected to substantially impact wildlife in the area, as those species present on base have adapted to living in close proximity to human activity, or because the conditions of the site do no currently provide habitat.

There are no known threatened or endangered species present within or adjacent to the footprint of the any of the alternative sites. Coordination with the USFWS and MA NHESP in November 2011 confirms that the proposed project is not anticipated to impact threatened or endangered species (see Appendix A).

4.5.2 No Action

The No Action alternative would not result in any short or long term impacts to vegetation, wildlife, or threatened/endangered species on HAFB or the MIT LL campus.

4.5.3 Preferred Alternative (C/J Lot)

For the Preferred Alternative (C/J Lot), impacts on vegetation would generally be short-term, as the existing vegetated islands within the parking lot would be removed to make room for the footprint of the building, resulting in a small loss of both trees and grassed areas.

Construction of the replacement facility is not expected to substantially impact wildlife in the area, as the existing parking area and small vegetated islands do not currently provide significant habitat due to the site's developed condition and frequent human traffic.

4.5.4 Alternative 2 (J Building)

Due to the developed nature of the existing site, impacts to vegetation would be minimal. Construction of the replacement facility would require grading and excavation, resulting in the loss of some existing vegetation. While the majority of the building's footprint would coincide with area that is currently either building or paved surface (i.e. devoid of vegetation), approximately 20% of the site is presently mowed grass, which would be removed during construction.

Construction of the replacement facility is not expected to substantially impact wildlife in the area, as the existing J Building and adjacent parking area do not currently provide significant habitat due to the site's developed condition, routine mowing, and frequent human traffic.

4.5.5 Alternative 3 (Hillside at Gate 3A)

For construction of the proposed building at Alternative 3 (Hillside at Gate 3A), impacts on vegetation would be both short- and long-term. To construct the proposed building, it would be necessary to clear a portion of the wooded hillside, resulting in the loss of approximately 900 trees >4 inches dbh. As noted in Section 3.5.4, of the 814 acres which comprise HAFB, approximately 180 are wooded (22 percent). The clearing of approximately 5 acres to facilitate construction for Alternative 3 would result in the loss of 2.8% of the total wooded area on HAFB. Recognizing that the loss of these trees may be significant, MIT LL has developed a mitigation plan to plant trees elsewhere on HAFB to offset this impact (AECOM, 2013c). If the Hillside at Gate 3A were selected as the site for the replacement facility, the ultimate location of the tree mitigation would be determined in co-ordination with HAFB during design. Time of year restrictions may be imposed on tree cutting (in coordination with HAFB), such that trees would be cut in the late fall or winter, prior to the Spring nesting/breeding period for birds, to ensure that no nests or eggs are destroyed, in accordance with the Migratory Bird Treaty Act (MBTA).

As mentioned in Section 4.5.1, a landscaped buffer would be established around the perimeter of the building superstructure. The area would be seeded and planted to create an aesthetically landscaped area that would transition to the more dense, undisturbed woodlot remaining on the hillside. The landscaping plan, to be submitted by MIT LL to HAFB for approval, would favor native species and exclude non-native species considered to be weedy or invasive by the United States Department of Agriculture.

At the location of Alternative 3 (Hillside at Gate 3A), it is anticipated that construction activities would displace birds and small mammals that utilize the vegetated areas for foraging or nesting. While there would be some permanent loss of habitat, the site is not located within proximity to wetlands, and therefore, the removal of vegetation is not subject to the MA Wetlands Protection Act. Furthermore, HAFB is in close proximity to the Great Meadows National Wildlife Refuge, which provides over 3,800 acres of permanently protected habitat.

4.5.6 Alternative 4 (AFRL Open Field)

For Alternative 4 (AFRL Open Field), the construction would displace the existing grass field and potentially two coniferous trees (depending on final site layout).

The existing open field does not provide significant habitat for wildlife; thus, construction of the replacement facility would not adversely impact wildlife in the area. While the proposed landscaping would slightly increase the vegetative diversity, this landscaped area is not expected to provide significant habitat, and would likely only be utilized by the occasional transient bird or small mammal.

4.6 CULTURAL RESOURCES

4.6.1 Common Effects

The nature and extent of potential impacts to historic and archaeological resources varies among the alternatives; thus, there are no common effects for this parameter.

4.6.2 No Action

Under the No Action alternative, no new facility would be constructed. Occupancy in the existing buildings would continue, and there would be expenditures related to operating costs and deferred maintenance; however, large scale renovations would not occur. The No Action alternative would not result in any short or long term impacts to historic or archaeological resources.

4.6.3 Preferred Alternative (C/J Lot)

The proposed facility at the Preferred Alternative (C/J Lot) would be constructed on the western side of the MIT LL main campus. While many of the nearby buildings within the MIT LL main campus are more than 50 years old, the majority of these buildings have undergone considerable alterations over the years. The proposed facility at the Preferred Alternative (C/J Lot) would be constructed in a setting having nearby buildings with considerable variation in age and architectural style. The older masonry block buildings to the east are contrasted sharply by the glass and metal modern appearance of the South Lab, built in the 1990s, to the southeast. The proposed building at the Preferred Alternative (C/J Lot) would be located approximately 800 feet north of the AFCRL Historic District, but would be predominantly obstructed from view of the historic district by intervening structures (such as the MIT LL parking garage) and vegetation.

It is anticipated that the replacement facility's design would have a modern style reflecting the state-of-the-art research to be conducted within its walls; however, the design may include architectural finishes that acknowledge the campus's historic role in designing and developing the nation's first air defense system. It is expected that the Preferred Alternative (C/J Lot) can be constructed and operated without adverse impact to historic resources.

Given the previous development at the location of the Preferred Alternative (C/J Lot), no extant archaeological resources are likely to be present. Thus, construction of the Preferred Alternative (C/J Lot) is not anticipated to have an adverse impact on archaeological resources.

As noted above, the Preferred Alternative (C/J Lot) is not located within a historic district, nor was it identified as having sensitivity for archaeological resources; therefore, no further coordination with MHC is expected if this alternative is selected.

4.6.4 Alternative 2 (J Building)

Prior to construction of the new facility, the existing J Building would be demolished. While the existing J Building was initially constructed more than 50 years ago (in 1957), it was not recommended as National Register eligible during the Architectural Building and Inventory Survey (PAL, 2003). The J Building has undergone numerous additions and renovations throughout the 1960s, 1970s, and 1980s; therefore, it does not maintain architectural integrity warranting consideration as a historical building. Thus, its demolition would not represent an impact to historic resources.

The proposed replacement facility would be constructed on the western side of the MIT LL main campus. The replacement facility at Alternative 2 (J Building) would be located approximately 1000 feet north of the AFCRL Historic District, but would be predominantly obstructed from view of the historic district by intervening structures (such as the MIT LL parking garage) and

vegetation. The nearby buildings have considerable variation in age and architectural style, and do not convey a unified historic character. The older masonry block buildings to the east are sharply contrasted by the glass and metal modern appearance of the South Lab. The proposed replacement facility's design is anticipated to be a modern style reflecting the state-of-the-art research to be conducted within its walls. It is expected that the proposed building could be designed, constructed, and operated without adverse impact to historic resources.

Given the previous development at J Building, no extant archaeological resources are likely to be present. Thus, construction of the replacement facility is not anticipated to have an adverse impact on archaeological resources, and no further coordination with MHC is expected if this alternative is selected.

4.6.5 Alternative 3 (Hillside at Gate 3A)

A portion of Alternative 3 (Hillside at Gate 3A) would be constructed within the recently designated AFCRL historic district; the remainder of the proposed building would be located immediately adjacent to the historic district. The proximity of the proposed replacement facility to the AFCRL historic district raises the potential for visual impact on the historic district. Alternative 3 (Hillside at Gate 3A) would incorporate features that convey the modern, state-of-the-art research role to be conducted within its walls. The design is likely to incorporate architectural features that enhance its location, just to the southwest of the modern South Lab. Through ongoing coordination with MHC, it is expected that Alternative 3 (Hillside at Gate 3A) can be constructed and operated without adverse impact to historic resources. HAFB is currently preparing a Programmatic Agreement that will address maintenance, new construction, leasing/transfer, and demolition of parcels within the AFCRL Historic District. The draft Programmatic Agreement is anticipated to be submitted to MHC in Summer/Fall 2013 and be in place with MHC in the near future; MIT LL intends to comply with the conditions detailed in the Programmatic Agreement.

The footprint of Alternative 3 (Hillside at Gate 3A) falls within one of 11 areas on HAFB previously identified as having a moderate/high sensitivity for the presence of archaeological resources. In anticipation of potential development on the hillside and as requested in a letter from MHC, dated March 14, 2012 (MHC, 2012b; Appendix A), PAL conducted an intensive archaeological survey of the proposed location of the new laboratory building in November 2012 (PAL, 2013). A total of 99 test pits (50 cm by 50 cm) were excavated within the potential project site. From all the test pits, only one small site, or locus, of pre-contact Native American cultural material was identified; this site consisted of three pieces of chipping debris (rhyolite, unidentified igneous rock). Close interval subsurface sampling indicated that this chipping debris is an isolated, low density deposit of pre-contact Native American cultural material. PAL concluded that the find has low information content and does not represent a potentially significant cultural resource, and recommended no further archaeological investigation (PAL,

2013). Based on this recent archaeological investigation, MHC confirmed in a letter dated 5 July 2013 that construction of the proposed replacement facility would have a low potential to impact archaeological resources. In the event that cultural artifacts are uncovered during construction, activities will be stopped and appropriate personnel would be contacted. If a significant archaeological resource is uncovered, it is anticipated that the artifact would be carefully excavated, in coordination with MHC and HAFB. Depending on the type of artifact, MIT LL may transfer the artifact to the Minute Man National Historic Park or a local historic society for curation.

4.6.6 Alternative 4 (AFRL Open Field)

The replacement facility at Alternative 4 (AFRL Open Field) would be constructed within the recently designated AFCRL historic district, thereby raising the potential for visual impact on the historic district. Alternative 4 (AFRL Open Field) would incorporate features that convey the modern, state-of-the-art research role to be conducted within its walls. A modern design would contrast with the existing buildings in the Lower ARFL (former Phillips Lab), whose construction reflects the more austere masonry block architecture of the late 1950s and early 1960s. If this site were selected, it is expected that Alternative 4 (AFRL Open Field) can be constructed and operated, through ongoing coordination with MHC, without adverse impact to historic resources. It is anticipated that the design of the proposed replacement facility would include architectural features that acknowledge the historic district's role in early geophysics research and development. HAFB is currently preparing a Programmatic Agreement that will address maintenance, new construction, leasing/transfer, and demolition of parcels within the AFCRL Historic District. The draft Programmatic Agreement is anticipated to be submitted to MHC in Summer/Fall 2013 and be in place with MHC in the near future; MIT LL intends to comply with the conditions detailed in the Programmatic Agreement.

Given the previous disturbance at the open field, no extant archaeological resources are likely to be present. Thus, construction of the replacement facility is not anticipated to have an adverse impact on archaeological resources.

4.7 AIR QUALITY

4.7.1 Common Effects

Short-term localized air quality impacts may occur at any of the four alternative sites, as construction could generate fugitive dust, particularly during site clearing, grubbing, excavation, and grading. Standard BMPs, such as watering to control dust plumes, covering trucks and stockpiled materials with tarps, and revegetating disturbed land as soon as possible would be implemented to minimize impacts. Additionally, all construction vehicles and some equipment would produce engine emissions, including ozone precursors, which could temporarily affect air

quality. However, construction-related emissions are, by definition, temporary and would cease after the buildings are complete. Construction emissions are unevenly distributed and generally highest during the early stages of construction, decreasing quickly after the earth-moving activities associated with site preparation and foundation work end. It is anticipated that any construction equipment with an engine greater than 50 horsepower would meet Tier 2, Tier 3, or newer (depending on the engine model year) USEPA emissions standards (including standards for hydrocarbons, NO_x, carbon monoxide, and particulate matter) for nonroad diesel engines and equipment. Additionally, equipment and vehicle idling would be limited to minimize impacts.

The proposed replacement facility would need to be heated, cooled, and ventilated; backup power would need to be provided. Each of these activities could represent a new source of (or an increase in) air emissions, thereby adversely impacting air quality.

If the new building were to be heated by the HAFB Central Heat Plant, the impact on air quality would not be meaningfully distinguished from the overall emissions of the CHP. The incremental demand from the replacement facility would not require the CHP to increase output beyond its already permitted emission levels; thus, no adverse impact is expected. If the heating is decentralized, the proposed replacement facility is expected to require stand-alone boiler(s) having a maximum heat input rating of 19,000,000 BTU/hour. The boiler(s) may exceed the Massachusetts Air Pollution Control regulations requiring Limited Air Plan Approval (310 CMR 7.02 (4)), since the boilers would have a maximum energy input capacity greater than 10,000,000 BTU/hour and less than 30,000,000 BTU/hour utilizing distillate fuel and the subsequent operation would result in an increase in potential emissions of a single air contaminant equal to or greater than one ton per year. The anticipated likely annual emissions from the boilers proposed for the replacement facility are presented in Table 4.7-1, based on 4,320 hours of operation in a typical year. The regulatory “potential to emit” emissions from the boilers proposed, based on continuous operation (i.e. 24 hours/day X 365 days/year) are presented in Table 4.7-2.

Table 4.7-1 Estimated Annual Emissions from Boiler (tons/year)

Annual Hours[1]	Diesel Boiler Emission Factor (lb/MMBTU)[2]			Annual Emissions (TPY)		
	NO_x	VOC[3]	CO	NO_x	VOC	CO
4320	0.143	0.004	0.036	5.86	0.16	1.47

[1] – Cold weather months operating 16 hours per day continuously for heat and hot water.
Warm weather months operating 8 hours per day continuously for hot water.
[2] – USEPA AP-42 emission factors for external combustion fuel oil (diesel fuel). 140 MMBTU/10^3 gal
[3] – VOC emissions use TOC emission factor

Table 4.7-2 Potential To Emit Annual Emissions from Boiler (tons/year)

Annual Hours	Diesel Boiler Emission Factor (lb/MMBTU)[1]			Annual Emissions (TPY)		
	NO_x	VOC[2]	CO	NO_x	VOC	CO
8760	0.143	0.004	0.036	11.89	0.33	2.97

[1] – USEPA AP-42 emission factors for external combustion fuel oil (diesel fuel). 140 MMBTU/10^3 gal
[2] – VOC emissions use TOC emission factor

The proposed building would have standby diesel-powered generator(s). The generator(s) is anticipated to be capable of supplying a total of 1.0 MegaWatts (MW); two 500 kW units are anticipated. The Massachusetts Air Pollution Control regulations require a Limited Plan Approval (LPA) [310 CMR 7.02(4)] for any facility where the operation could result in an increase in potential emissions of a single air contaminant equal to or greater that one ton per year and a Comprehensive Air Plan Approval (CPA) [310 CMR 7.02(5)] for any facility where the operation could result in an increase in potential emissions of a single air contaminant equal to or greater than ten tons per year. However; permitting applicability thresholds for new emergency engines are established in MA Air Regulations at 310 CMR 7.26 (42) under the Environmental Results Permitting (ERP) Program for new emergency engines. If an emergency generator has a rated output of 0.037 MW or greater and is constructed after March 1, 2006; the emergency generator is subject to 310 CMR 7.26 (42) and not subject to either LPA [310 CMR 7.02(4)] or CPA [310 CMR 7.02(5)]. Emissions limits are based on EPA Non-Road Engines Regulations under 40 CFR Part 89 at time of installation of the engine. Fuel type is limited to ultra-low sulfur diesel or natural gas and hours of operation are limited to 300 hours per year under 310 CMR 7.26 (42). A permit application would be submitted under the ERP program to obtain approval for the emergency generator(s). Any installed emergency generator would comply with EPA's National Emission Standards for HAPs for Area Sources (40 CFR Part 63, revised February 1, 2013). The anticipated annual emissions from the generator proposed for the Proposed Action are presented in Table 4.7-3.

Table 4.7-3 Estimated Annual Emissions from Emergency Generators

Annual Hours	Diesel Generator Emission Factor (lb/hp-hr)[1]			Annual Emissions (TPY)		
	NO_x[2]	VOC[3]	CO	NO_x	VOC	CO
300	0.024	0.00071	0.0055	4.83	0.14	1.11

[1] – USEPA AP-42 emission factors for large diesel engines.
[2] – Uncontrolled NO_x emission factor
[3] – VOC emissions use TOC (as CH_4) emission factor

Since MIT LL presently has a Comprehensive Air Plan that addresses the facility, it is anticipated that an amendment would be filed, or a new application submitted, to obtain MassDEP's approval for the facility.

The total emissions of the stationary sources (i.e. boilers and generators) are anticipated to be approximately 10.7 tons/year of NO_x, 0.3 tons/year for VOC, and 2.6 tons/year for CO. The combination of these stationary sources and estimated construction-related mobile emissions would not exceed the *de minimus* thresholds of 100 tons per year for NO_x and CO, and 50 tons per year for VOC; therefore, the Proposed Action would conform with the State Implementation Plan. The project would not trigger either a Prevention of Significant Deterioration (PSD) or a non-attainment new source review. Major source emissions thresholds in Massachusetts are 50 tons per year for NO_x and VOC. The Proposed Action with the existing permitted combustion sources would not trigger Title V Operating Permit review.

The replacement facility would have a number of ducted fume hoods discharging through roof vents. MIT LL would install hoods that are designed to reduce and neutralize any discharge of noxious fumes with makeup air. The fume hoods are not anticipated to represent a significant source of hazardous air pollutants.

The Clean Air Act requires that actions of federal agencies or federally supported activities should not: 1) cause or contribute to any new air quality standard violation; 2) increase the frequency or severity of any existing standard violation; or 3) delay the timely attainment of any standard or any required interim emission reductions or other milestones. Under Section 176(c) of the Clean Air Act, a project is in “conformity” if it corresponds to the State Implementation Plan’s (SIP) purpose of eliminating or reducing the severity and number of violations of the NAAQS, and achieving the expeditious attainment of the standards. The EPA published final rules on general conformity (40 CFR Parts 51 and 93 in the Federal Register on November 30, 1993 and revised on March 24, 2010) that apply to federal actions in areas in non-attainment for any of the criteria pollutants. A formal conformity determination is required when the annual net total of direct and indirect emissions from a federal action occurring in a non-attainment area equals or exceeds the applicable *de minimis* levels. Since the project is located in Massachusetts, which is currently designated as non-attainment for ozone and maintenance for CO, a quantitative general conformity applicability analysis has been completed for the Proposed Action and included in the evaluation of anticipated air quality effects included in Appendix B, Conformity Analysis (Air Quality).

Climate Change and Greenhouse Gasses

The Air Force must comply with EO 13514, entitled *Federal Leadership in Environmental, Energy, and Economic Performance,* which calls for federal agencies to lead by example in the areas of clean energy and the environment. The EO includes new GHG emissions requirements for emissions reductions and inventory. Emissions from MIT LL are not included in HAFB’s annual GHG emissions inventories. However, MIT LL is committed to complying with applicable federal and state policies that address GHG and climate change.

If stand-alone chillers are utilized to cool the buildings, MIT LL will utilize R-134a or another EPA-approved non ozone-depleting substance. The proposed stationary sources (i.e. boilers and generators) would be estimated to result in the generation of approximately 6,700 tons/year of CO_2 emissions. When compared to regional emissions, the amount of GHG to be generated by the Proposed Action is small. The CEQ's *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* suggests that actions which would be reasonably anticipated to emit less than 25,000 metric tons of CO_2 do not exceed a significance threshold.

4.7.2 No Action

Under the No Action alternative, no new facility would be constructed. Occupancy in the existing buildings would continue, and there would be expenditures related to operating costs and deferred maintenance; however, large scale renovations would not occur. Total air emissions from MIT LL, associated predominantly with diesel-powered emergency generators and various boilers, would be expected to remain at volumes similar to those generated under current operations.

4.7.3 Preferred Alternative (C/J Lot)

There are no appreciable differences in construction or operations emissions, as the boilers and emergency generator(s) would be the same size, regardless of the alternative selected. Thus, there are no additional impacts for the Preferred Alternative (C/J Lot) beyond what is described above under Common Effects.

4.7.4 Alternative 2 (J Building)

There are no appreciable differences in construction or operations emissions, as the boilers and emergency generator(s) would be the same size, regardless of the alternative selected. Thus, there are no additional impacts for Alternative 2 (J Building) beyond what is described above under Common Effects. However, these estimates are conservative in that no credit has been taken for the demolition of the existing J Building, which would somewhat reduce demand on the CHP.

4.7.5 Alternative 3 (Hillside at Gate 3A)

There are no appreciable differences in construction or operations emissions, as the boilers and emergency generator(s) would be the same size, regardless of the alternative selected. Thus, there are no additional impacts for Alternative 3 (Hillside at Gate 3A) beyond what is described above under Common Effects.

4.7.6 Alternative 4 (AFRL Open Field)

There are no appreciable differences in construction or operations emissions, as the boilers and emergency generator(s) would be the same size, regardless of the alternative selected. Thus, there are no additional impacts for Alternative 4 (AFRL Open Field) beyond what is described above under Common Effects.

4.8 NOISE

4.8.1 Common Effects

Construction of the proposed facility would result in a short-term increase in noise levels within the vicinity of construction, related to use of equipment such as bulldozers, backhoes/excavators, graders, cranes, generators, and other heavy equipment. While the overall duration of construction is expected to be approximately 2.5 years, the highest construction noise levels are expected to occur during the first phases of construction, when the site is cleared and the foundation is excavated. These elevated noise levels are not likely to significantly disrupt the activities in nearby office and laboratory buildings, given the noise attenuation provided by distance and the surrounding buildings' walls and closed windows. During later stages of construction, an increasing percentage of the work would occur within the building interior, such as installation of ductwork, and thus would not generate much fugitive noise.

No long-term noise impacts are anticipated to result from operation of the proposed replacement facility. The activities which would be carried out in the new facility would not be expected to generate significant levels of noise as they are similar office/lab functions to those in surrounding buildings. While the facility would have HVAC equipment and a standby generator to support life safety systems (emergency lights, alarms, signage), both of which produce intermittent noise, the contribution of noise to the surrounding area is expected to be consistent with the persistent nature of existing noise produced from the developed environment. Noise levels generated by the facility operation would be maintained at a level consistent with current OSHA regulations as specified in CFR Title 29, Part 1910

4.8.2 No Action

Under the No Action alternative, no new facility would be constructed. Occupancy in the existing buildings would continue; however, large scale renovations would not occur. The No Action alternative would not result in a change in the ambient noise levels at HAFB or MIT LL.

4.8.3 Preferred Alternative (C/J Lot)

For the Preferred Alternative (C/J Lot), there are no additional noise impacts beyond those described above in the Common Effects.

4.8.4 Alternative 2 (J Building)

In addition to the construction noise described in Section 4.8.1, demolition of the existing J Building would result in a short-term increase in noise levels in the vicinity of the demolition activities, anticipated to utilize large hydraulic equipment, cranes, high-reach excavators, bulldozers, and/or hoe-rams.

4.8.5 Alternative 3 (Hillside at Gate 3A)

For Alternative 3 (Hillside at Gate 3A), there are no additional noise impacts beyond those described above in the Common Effects.

4.8.6 Alternative 4 (AFRL Open Field)

For Alternative 4 (AFRL Open Field), there are no additional noise impacts beyond those described above in the Common Effects.

4.9 INFRASTRUCTURE

4.9.1 Common Effects

Water Supply

A temporary increase in water demand would occur during construction. Due to the limited number of construction workers and the adequate supply of water to the base, it is not anticipated that the water demand both for workers' personal need and dust control during construction would adversely impact the water supply at HAFB.

The operation of the proposed replacement facility on base may slightly increase water demand due to the general functions of the building; however, operation would not increase demand for potable water at HAFB beyond the available supply. The replacement facility would be equipped with water conserving devices, consistent with DoD guidance to reduce potable use. With implementation of conservation measures, water consumption in the replacement facility is anticipated to be less than the current usage of approximately 25 gallons per square foot per year (i.e. approximately 7,000,000 gallons/year) for the existing similar laboratories.

Wastewater Treatment

There would be an insignificant short-term increase in demand for sewage treatment during construction of the replacement facility. Portable toilets would be available during the construction, and waste would be transported to a nearby treatment facility.

Operation of the replacement facility would slightly increase the volume of wastewater generated; however, the current sewer system is adequate and can accommodate moderate growth. MIT LL would need to amend its MWRA Discharge Permit to include the new locations from which wastewater would be generated and modify the sampling plan accordingly.

An acid waste system would be provided for the replacement facility to collect non-fluorinated acid drains from acid and base wet benches, floor drains, and other miscellaneous drains. The acid waste system would consist of double-wall polypropylene piping with equipment connection points at regular intervals. The piping system would have electro-fusion welded joints. Acid waste laterals would be provided in each wet process bay. The acid waste piping system vents would be directed to acid / corrosive scrubbed exhaust. Acid waste would be conveyed to a packaged, fully automated acid waste neutralization (AWN) system for pH adjustment prior to discharging into the sanitary drainage system.

Storm Drainage

Construction of the proposed facility would result in short-term impacts to the storm drainage system. Ground disturbance and periods of exposed soil may result in suspended solids being conveyed into the drainage system during heavy rainfall. However, sedimentation and erosion control measures, such as the use of temporary drainage swales, temporary diversion dikes, sediment traps, and/or compost filter socks or silt fence, would be implemented prior to and during construction to reduce the potential for impact, in accordance with a Stormwater Pollution Prevention Plan (SWPPP).

Additionally, the design of the proposed replacement facility would include stormwater BMPs (such as a green roof, subsurface infiltration system, or a retention basin) to reduce runoff during a storm and retain or infiltrate water on site (or nearby) in accordance with HAFB's drainage requirements.

Electricity

Short-term disruption of power to the immediate area around any of the four alternative sites may occur while electrical connections are made to the new facility. Any interruptions in electrical service would be expected to be of very short duration, and the work would be scheduled to have as minimal as possible impact on the tenants of the surrounding buildings.

The operation of the proposed replacement facility would increase the demand for, and use of, electricity at MIT LL; however, HAFB's electrical demand is well below the capacity of the transmission lines on base. Additionally, the design of the proposed replacement facility is anticipated to incorporate energy conservation technologies, such as high efficiency lighting and/or motion-activated sensors/timers for room lighting, consistent with DoD guidance for energy efficiency.

Telecommunications
No short or long-term impacts are anticipated to occur at any of the four alternative sites. Telephone and fiber optic lines would be extended to the proposed building. No disruption of telephone or data service to nearby buildings is anticipated.

Natural Gas
The relocation of the gas line(s), if necessary, would be coordinated with HAFB and the gas utility owner. Prior to construction of the replacement facility, existing natural gas distribution lines would be identified and properly marked, to minimize accident potential. Should final design of the replacement facility include a requirement for natural gas, new service laterals would be installed to provide service to the building. While the HAFB natural gas distribution system currently has capacity limitations, these issues are being addressed by MIT LL with HAFB; system upgrades by HAFB are planned as part of a separate action. Tennaco will likely provide a new gas connection and distribution building, and HAFB will likely provide the distribution system. The National Grid system may potentially be abandoned. The use of natural gas within the replacement facility would not be expected to increase demand for natural gas at HAFB beyond the anticipated capacity of the distribution system assuming the system is upgraded prior to the construction of Phase 1. If proposed upgrades are not scheduled until after the construction of Phase 1, it may be necessary to bring in new service from National Grid.

Central Heating and Cooling Systems
Depending on the heating and/or cooling option selected for the proposed replacement facility, new piping may be installed to connect the proposed building to the HAFB CHP distribution system and/or the MIT LL CWP distribution system.

If the proposed replacement facility were to obtain heat (via steam) from the HAFB CHP, the estimated maximum demand would be 8,100 to 13,000 pounds per hour. While some improvements to CHP efficiency and distribution system efficiency have been made in the past decade, there has been no increase in approved capacity. Without a reduction in demand from other users, or further reductions in heat losses from the existing distribution network, connection of the MIT LL replacement facility to the HAFB CHP could increase the number of hours/days when the HAFB CHP must operate all four boilers simultaneously, without any standby capacity. As a result, MIT LL is proposing to provide heat and hot water to the replacement facility via stand-alone boilers to be installed in the new building. If MIT LL

utilizes stand-alone boilers, there would be no impact on the HAFB CHP. Air permitting for the stand-alone boilers is discussed in Section 4.7, Air Quality.

With regard to cooling, it is anticipated that the proposed replacement facility would be connected to the MIT LL CWP, where incremental capacity can be added without significant impact to existing infrastructure. Alternately, MIT LL is also considering the use of stand-alone chillers. If stand-alone units are employed, there would not be a need to increase the capacity at the MIT LL CWP. Air permitting for the proposed cooling plant is discussed in Section 4.7, Air Quality.

Fire Protection

No impacts to fire protection on HAFB or MIT LL are anticipated to result from the replacement facility regardless of alternative. The replacement facility would include a fire suppression system, alarms linked to central command, and other preventative measures to ensure the safety of personnel. Primary emergency response would be provided by the HAFB Fire Department, consistent with current practice for the MIT LL campus.

4.9.2 No Action

The No Action alternative would result in the continued occupancy of aging, over-crowded facilities on the MIT LL main campus. As there would be no new construction, there would be no change or additional demand on existing infrastructure within MIT LL or HAFB.

4.9.3 Preferred Alternative (C/J Lot)

Water Supply

There may be some short-term interruptions to service during construction as some existing utilities lines may need to be rerouted [such as the existing water line which crosses the footprint of the Preferred Alternative (C/J Lot)] or during the connection of the new facility to the existing utility lines.

Wastewater Treatment

An existing wastewater line, which would need to be re-routed, is located within the footprint of the Preferred Alternative (C/J Lot). Wastewater flows in this line would be temporarily pumped/by-passed to facilitate re-routing the existing utility around the proposed replacement facility.

Storm Drainage

Existing drainage pipelines located within the proposed footprint of the Preferred Alternative (C/J Lot) would be re-routed around the proposed replacement facility.

As described in Section 4.4.3, while the project would result in an increase in impervious surfaces, the Preferred Alternative (C/J Lot) is not anticipated to result in long term adverse impacts to the storm drainage system.

Electricity
A number of electrical lines located within the footprint of the site which would be re-routed, potentially resulting in brief service disruptions to nearby buildings. Any interruptions in electrical service would be expected to be of very short duration, and the work would be scheduled to have as minimal as possible impact on the tenants of the surrounding buildings.

Connection of the Preferred Alternative (C/J Lot) to the electrical distribution system would be made from existing distribution lines abutting the site.

Telecommunications
No additional impacts are anticipated at the Preferred Alternative (C/J Lot) beyond what is described in the Common Effects subsection.

Natural Gas
Construction of the proposed facility at the Preferred Alternative (C/J Lot) would require relocation of an existing natural gas line at the western end of the footprint of the proposed facility.

Central Heating and Cooling Systems
Construction of the proposed facility at the Preferred Alternative (C/J Lot) would require relocation of steam lines and chilled water supply/return lines located within the proposed footprint.

Fire Protection
No additional impacts are anticipated at the Preferred Alternative (C/J Lot) beyond what is described in the Common Effects subsection.

4.9.4 Alternative 2 (J Building)

Water Supply
There may be some short-term pressure reductions or interruptions in service during the connection of the replacement facility to existing water distribution lines that circumscribe the existing J Building.

Wastewater Treatment
No additional impacts are anticipated at Alternative 2 (J Building) beyond what is described in the Common Effects subsection.

Storm Drainage

As described in Section 4.4.4, since redevelopment within the existing J Building parcel would not significantly increase the amount of impervious surface, the proposed replacement facility is not anticipated to result in long-term adverse impacts to the storm drainage system.

Electricity

Short-term disruption of power to the immediate area around J Building may occur while electrical lines are disconnected from J Building prior to demolition. Any interruptions in electrical service would be brief, and the work would be scheduled to have as minimal as possible impact on the tenants of surrounding buildings. Connection of the proposed replacement facility to the electrical distribution system would be made from existing distribution lines abutting the site.

Telecommunications

No additional impacts are anticipated at Alternative 2 (J Building) beyond what is described in the Common Effects subsection.

Natural Gas

Demolition of the existing J Building is not anticipated to have an adverse impact on natural gas utilities. Prior to demolition, existing natural gas distribution lines would be identified and properly marked, to minimize accident potential. Construction of the proposed replacement facility may require the relocation (or removal) of one or two, possibly abandoned, natural gas lines potentially within the footprint of the proposed facility.

Central Heating and Cooling Systems

Construction of the proposed replacement facility would require the relocation of steam lines and chilled water supply/return lines located within the proposed footprint of the new building. No additional impacts are anticipated at Alternative 2 (J Building) beyond what is described in the Common Effects subsection.

Fire Protection

No additional impacts are anticipated at Alternative 2 (J Building) beyond what is described in the Common Effects subsection.

4.9.5 Alternative 3 (Hillside at Gate 3A)

Water Supply

For Alternative 3 (Hillside at Gate 3A), a water line would be extended to the new facility from the existing lines located in Schilling Circle, approximately 130 feet away.

Wastewater Treatment

Wastewater utility lines would be extended approximately 170 feet to the location of Alternative 3 (Hillside at Gate 3A).

Storm Drainage

As described in Section 4.4.5, while the project would result in an increase in impervious surfaces, Alternative 3 (Hillside at Gate 3A) is not anticipated to result in long term adverse impacts to the storm drainage system. Given the proposed increase in impervious surfaces, the stormwater management design would be challenging, but feasible.

Electricity

Connection of replacement facility to the electrical distribution system would likely be made from existing distribution lines located approximately 100 feet north.

Telecommunications

No additional impacts are anticipated at Alternative 3 (Hillside at Gate 3A) beyond what is described in the Common Effects subsection.

Natural Gas

No natural gas lines are known to be present within the footprint of Alternative 3 (Hillside at Gate 3A). Therefore, no additional impacts are anticipated at Alternative 3 (Hillside at Gate 3A) beyond what is described in the Common Effects subsection.

Central Heating and Cooling Systems

No additional impacts are anticipated beyond what is described in the Common Effects subsection as no heating or cooling infrastructure would need to be relocated for construction of Alternative 3 (Hillside at Gate 3A).

Fire Protection

No additional impacts are anticipated at Alternative 3 (Hillside at Gate 3A) beyond what is described in the Common Effects subsection.

4.9.6 Alternative 4 (AFRL Open Field)

Water Supply

Short-term interruptions to service may occur during connection of the new building to existing utility lines along Randolph Road or Grenier Street.

Wastewater Treatment

A new pipe would be installed to convey wastewater from the proposed building to the existing gravity sewer located along Grenier Street.

Storm Drainage

As described in Section 4.4.6, while the project would result in an increase in impervious surfaces, the proposed replacement facility is not anticipated to result in long term adverse impacts to the storm drainage system. Given the proposed increase in impervious surfaces, the stormwater management design would be challenging, but feasible.

Electricity

Electrical connections to the new building would be made from nearby distribution lines along either Randolph Road or Grenier Street.

Telecommunications

No additional impacts are anticipated at Alternative 4 (AFRL Open Field) beyond what is described in the Common Effects subsection.

Natural Gas

No natural gas lines are known to be present within the footprint of the proposed replacement facility. Therefore, no additional impacts are anticipated at Alternative 4 (AFRL Open Field) beyond what is described in the Common Effects subsection.

Central Heating and Cooling Systems

Construction of the proposed replacement facility may require the relocation of steam lines and chilled water supply/return lines located near the eastern edge of the proposed footprint of the new building.

Fire Protection

No additional impacts are anticipated at Alternative 4 (AFRL Open Field) beyond what is described in the Common Effects subsection.

4.10 TRANSPORTATION

Recognizing that existing parking conditions on base are not optimal, MIT LL, in cooperation with HAFB, recently conducted a parking study that addressed the entire MIT LL campus (AECOM, 2013d). Within the overall study area limits, there are over 4,100 parking spaces, and a surplus of 850 spaces. However, five of the seven parking subareas are at or near capacity, and the largest number of surplus spaces are outside of a 6-minute walk from the MIT LL main campus. The findings of the parking study, where relevant to the alternative sites, are discussed below.

4.10.1 Common Effects

Impacts to transportation systems at/near HAFB and MIT LL during construction would be minimal. Increased activity in the vicinity of the site, including connection of the proposed replacement facility to existing utilities, could temporarily disrupt local traffic on HAFB and/or MIT LL. Personal and commercial vehicles operated by the contractor and subcontractors would be on site or at an area designated by HAFB or MIT LL. The types of construction vehicles used for the construction of the replacement facility are not anticipated to be different from those used for other base construction projects. Therefore, the cement trucks and other construction vehicles necessary for construction are not expected to have an impact on base roads.

During operation, the proposed replacement facility would not result in the generation of any new trips onto HAFB or MIT LL. While the traffic analysis completed in 2010-2011 for the nearby Army National Guard Joint Forces Headquarters building documented that all key intersections in the surrounding communities experience traffic delays, the long-term operation of the replacement facility is not expected to contribute to additional traffic delays, as the Proposed Action is not anticipated to result in an increase in the number of people employed at MIT LL. Existing personnel that currently work in other buildings on the MIT LL campus would ultimately shift to working in the replacement facility upon completion. Thus, the volume of traffic entering/exiting MIT LL and HAFB would be similar to current conditions.

4.10.2 No Action

The No Action alternative would not alter traffic or parking conditions on or around HAFB or MIT LL. Congested traffic conditions in the vicinity of the base and localized parking shortages within the MIT LL campus and portions of HAFB would be anticipated to continue.

4.10.3 Preferred Alternative (C/J Lot)

Traffic

No additional impacts are anticipated at the Preferred Alternative (C/J Lot) beyond what is described in the Common Effects subsection.

Parking

Construction of the proposed facility at the Preferred Alternative (C/J Lot) would result in the removal of the existing parking lot and permanent displacement of approximately 205 existing parking spaces near the existing J Building. During construction, an additional 42 spaces would be unavailable for use. The immediate consequence of construction would be to increase competition for spaces in the C/J, FA and Brown Building parking area, since demand noticeably would exceed supply. While in theory the deficit in this specific parking area would be 191 spaces, in practice this excess demand would be satisfied in one of two ways: parking usage

would increase in more distant spaces in other parking areas, or employees would park in non-designated or unauthorized areas. However, during the construction of the replacement facility, sufficient parking spaces would still exist within the overall study area to satisfy demand, whether looking at gross or practical capacity. It is anticipated that a higher number of vehicles would park in the Lower AFRL and Bestic areas, where surplus capacity more than offsets the number of parking spaces lost to construction activities associated with the replacement facility.

Upon completion of construction, 42 parking spaces would be restored to the parking supply at the C/J parking area. The replacement facility would house approximately 100 employees who would relocate from other buildings on the MIT LL main campus. Given the shift in their assigned building, it is likely that some of the affected employees would choose to park in different locations than currently exhibited. As a result, reduced demand in the CWP, M/L, and L subareas would favorably affect the current shortfall in those parking areas, while competition for spaces closest to the proposed replacement facility would increase. Since there would be no net change in capacity or demand associated with the employee relocations, the overall conclusions noted previously do not change upon occupation of the replacement facility; i.e. sufficient parking spaces would still exist within the overall study area to satisfy demand, whether looking at gross or practical capacity. Additionally, signage could be provided in some of the remaining spaces in the C/J Lot to allow for dedicated spaces for Building 1305 (Brown Building), as this is an HAFB customer service facility which includes retiree services.

4.10.4 Alternative 2 (J Building)

Traffic

In addition to the Common Effects, impacts to the transportation systems at/near HAFB and MIT LL due to demolition of the existing J Building would be minimal. Increased activity in the vicinity of demolition activities could temporarily disrupt local traffic on HAFB and/or MIT LL. The types of construction vehicles to be used for the demolition effort are not anticipated to be different than those used for other base construction projects.

Parking

Construction of the Alternative 2 (J Building) would result in the permanent displacement of approximately 230 existing parking spaces near the existing J Building. The replacement facility would be designed to comply with the UFC setbacks between buildings and parking areas, thereby eliminating the potential to re-establish parking spaces within approximately 55 feet of the new building's perimeter. As with the Preferred Alternative, the immediate consequence of construction would be to increase competition for spaces in the C/J, FA and Brown Building parking area, since demand noticeably would exceed supply. However, since the J Building would be vacated prior to demolition, some of this demand may be relocated to other parking areas within the MIT LL campus or HAFB. During construction of the replacement facility, sufficient parking spaces would still exist within the overall study area to satisfy demand,

whether looking at gross or practical capacity. It is anticipated that a higher number of vehicles would park in the Lower AFRL and Bestic areas, where surplus capacity more than offsets the number of parking spaces lost to construction activities associated with the replacement facility.

The replacement facility would house approximately 100 employees who would relocate from other buildings on the MIT LL main campus. Given the shift in their assigned building, it is likely that some of the affected employees would choose to park in different locations than currently exhibited. As a result, reduced demand in the CWP, M/L, and L subareas would favorably affect the current shortfall in those parking areas, while competition for spaces closest to the proposed replacement facility would increase. Since there would be no net change in capacity or demand associated with the employee relocations, the overall conclusions noted previously do not change upon occupation of the replacement facility; i.e. sufficient parking spaces would still exist within the overall study area to satisfy demand, whether looking at gross or practical capacity. Additionally, signage could be provided in some of the remaining spaces in the C/J Lot to allow for dedicated spaces for Building 1305 (Brown Building), as this is an HAFB customer service facility which includes retiree services.

4.10.5 Alternative 3 (Hillside at Gate 3A)

Traffic

No additional impacts are anticipated at Alternative 3 (Hillside at Gate 3A) beyond what is described in the Common Effects subsection.

Parking

For Alternative 3 (Hillside at Gate 3A), no parking spaces would be displaced by construction of the replacement facility. The conceptual plan for the replacement facility at this location does not include the creation of any new parking spaces. The lack of any new parking spaces was deliberate, based upon the following considerations: 1) MIT LL recognized the desirability of reducing the amount of new impervious surface to the maximum extent possible; 2) Occupants of the new building would simply relocate from existing buildings, and thus not require additional parking capacity. As a result, the replacement facility would neither increase nor decrease the total (gross/practical) capacity nor the total demand for parking spaces. However, that demand would likely shift in location. Based on proximity, a likely reduction in parking demand at CWP, M/L and L parking areas and at C/J, FA and Brown Building parking areas should occur as a result of this relocation. Use of the Parking Garage and South Lab lot would remain roughly the same. However, increases in demand would be expected at Katahdin Hill and Lower AFRL, as well as portions of the southerly Bestic lots.

4.10.6 Alternative 4 (AFRL Open Field)

Traffic

No additional impacts are anticipated at Alternative 4 (AFRL Open Field) beyond what is described in the Common Effects subsection.

Parking

No existing parking spaces would be displaced by construction of the replacement facility. Given its location within the existing open field, opportunity exists to establish a parking lot on-site adjacent to the proposed replacement facility. Employees of the new building would likely park adjacent to the proposed replacement facility or in the existing Lower AFRL Parking Lot, which commonly has surplus capacity. As the employees who would occupy the replacement facility would relocate from buildings within the MIT LL main campus, this would transfer some parking demand from an area of high demand (e.g. South Lab garage and adjacent surface lots) to an area with adequate capacity, thus lessening the parking shortfalls frequently experienced on the MIT LL main campus.

4.11 SOLID WASTES AND HAZARDOUS MATERIALS

4.11.1 Common Effects

Construction of the replacement facility would generate solid waste, primarily associated with packaging of construction materials. To the extent practicable, construction would utilize reused or recycled materials. Additionally, while some equipment in the existing facilities would be relocated to the replacement facility, other equipment that is out-dated or damaged would be removed and disposed. While construction would result in a short-term increase in solid waste, the diversion of reusable or recycled materials in the building construction would lessen the impact associated with new construction. Operation of the replacement facility is not expected to result in a significant increase in the volume of solid waste generated by MIT LL, as the laboratory activities are not anticipated to increase, but rather simply be re-organized and re-distributed across the MIT LL campus and HAFB. Solid waste generated at the replacement facility would be recycled or collected and disposed off-base, consistent with current practices and policies.

During construction, hazardous materials and waste would likely be used and generated, including: equipment fuel, engine oil, hydraulic oil, grease, and other equipment operation and maintenance material. Any hazardous materials used during construction would be used, stored, transported, and disposed in accordance with MIT LL policies and protocols and relevant state and federal regulations. Routine operations of the replacement facility would require the occasional use of toxic solvents or gasses. Purchase requisitions for hazardous chemicals, biological materials, and toxic gases would be routed through the MIT LL EHS Office for review and approval. Only after the MIT LL EHS Office approves the purchase requisition can the

Purchasing group place an order with a vendor/supplier. The storage of chemicals and disposal of hazardous wastes would be required to carry-out the functions intended for the proposed replacement facility. It is anticipated that a storage area may be located within the proposed replacement laboratory for the delivery of chemicals by the case and then distributed to the MIT LL buildings, or MIT LL may utilize a just-in-time delivery from chemical supply vendors with shipments made directly to the proposed buildings, or a combination of these approaches. Gas cylinders, including highly toxic gas cylinders, would be tracked throughout the laboratory via the HazTrack gas cylinder tracking system. Consistent with current practice at MIT LL, highly toxic gas storage and use areas are monitored by gas detection systems which are interlocked to gas delivery systems, connected to the building/facility emergency evacuation (fire alarm) alarm system, and supervised by the 24/7 Security Department Alarm Control Center. MIT LL may employ one, or a combination of, the following chemical disposal options: the pick-up of accumulated waste (in-house) with transport to a chemical storage facility for bulk packing and transport/disposal on a regular basis (three times per week), the creation of a 90-day storage area from which the in-house pickup would transport to the chemical storage facility and dispose of waste quarterly, or a chemical disposal contractor would provide an accumulation area with bulk-packaging and pick-up from multiple areas. The disposal of all MIT LL hazardous wastes would be coordinated through the Lincoln Laboratory Hazardous Waste Facility Personnel.

A list of hazardous chemicals to be used in each work area would be compiled and updated annually. When new hazardous chemicals are received, they would be added to the list, and chemicals no longer in use for that work area would be deleted. The list would include the name of the chemical as given on the label and SDS, the manufacturer, the use/storage location, CAS# if assigned, and the planned maximum quantity to be kept in inventory. A copy of the annual update would be maintained by the MIT LL EHS Office. A SARA Title III Hazardous Chemical Inventory reporting would be conducted for regulated SARA chemicals to meet the requirements of EPA’s Emergency Planning and Community Right-to-Know Act. Inventory location and quantity information is updated for the chemicals on this list and submitted to the local fire departments and local emergency planning committees. This inventory is coordinated with the Group EHS and SARA representatives for each lab area by the Laboratory EHS Office. TRI reporting will also be conducted along with SARA Title III reporting in the future. These inventory activities help with emergency pre-planning activities and also assist in identifying possible substitution candidates for less hazardous or non-hazardous chemicals.

There would be no net increase in the quantity of hazardous chemicals, nor change in the types of chemicals, stored. No changes in the accumulation, transport, and disposal of hazardous wastes are anticipated.

Emergency generator(s) would be installed outside the proposed replacement facility and would have an associated aboveground 2,000 gallon diesel fuel storage tank. Operation of the emergency generator(s) would result in periodic generation of waste oil/lubricants; however,

substantial quantities are not anticipated.

4.11.2 No Action

The No Action alternative would result in the continued occupancy of the facilities on the MIT LL main campus; however, there would be no new construction. Ongoing operations at MIT LL would continue to generate solid wastes and require the storage of fuels; the existing laboratories would continue to use hazardous materials and generate small quantities of hazardous wastes. It is anticipated that the remediation of prior contamination at HAFB would continue as part of the base's Environmental Restoration Program.

4.11.3 Preferred Alternative (C/J Lot)

The Preferred Alternative (C/J Lot) is not located within or adjacent to an Environmental Restoration Program site. It is not expected that construction activities would encounter contaminated soils or groundwater; however, if the soil/groundwater is observed to have an odor or sheen, it would be tested prior to disposal or discharge. Construction and operation of the replacement facility are not expected to have an adverse effect on HAFB's ongoing remediation activities.

4.11.4 Alternative 2 (J Building)

Prior to demolition of the J Building, a licensed Asbestos Inspector would complete a full building demolition asbestos inspection and identify quantities and locations of asbestos-containing materials so that materials can be properly disposed. There is the potential that caulking around the existing building's windows and exterior doorways, as well as between masonry joints, may contain PCBs. These materials are anticipated to be removed and disposed separately. Additionally prior to demolition, all fluorescent lamps and mercury containing thermostats would be removed from the building for proper disposal, and the HVAC system would be drained of all fluids. In this manner, the construction and demolition debris would be segregated from hazardous materials requiring special disposal in accordance with federal and state regulation.

Alternative 2 (J Building) is not located within or adjacent to an Environmental Restoration Program site. It is not expected that construction activities would encounter contaminated soils or groundwater; however, if the soil/groundwater is observed to have an odor or sheen, it would be tested prior to disposal or discharge. Construction and operation of the replacement facility are not expected to have an adverse effect on HAFB's ongoing remediation activities.

4.11.5 Alternative 3 (Hillside at Gate 3A)

Alternative 3 (Hillside at Gate 3A) is not located within an Environmental Restoration Program site; however, ERP Site 10 is associated with the nearby Building 1128 to the south. A response action has been completed at this ERP site; therefore, it is not expected that construction

activities associated with the replacement facility would encounter contaminated soils or groundwater. However, if the soil/groundwater is observed to have an odor or sheen, it would be tested prior to disposal or discharge. Construction and operation of the replacement facility are not expected to have an adverse effect on HAFB's ongoing remediation activities.

4.11.6 Alternative 4 (AFRL Open Field)

Alternative 4 (AFRL Open Field) is not located within or adjacent to an Environmental Restoration Program site. It is not expected that construction activities would encounter contaminated soils or groundwater; however, if the soil/groundwater is observed to have an odor or sheen, it would be tested prior to disposal or discharge. Construction and operation of the replacement facility are not expected to have an adverse effect on HAFB's ongoing remediation activities.

4.12 SOCIOECONOMIC CONDITIONS

4.12.1 Common Effects

Construction activities would generate a small benefit for the construction industry, as there would be a corresponding short-term increase in the demand for skilled workers and construction materials. Although a slight short-term increase in revenue generated in the surrounding area may occur due to construction employees utilizing local business for supplies and personal use, construction of the replacement facility is not expected to significantly impact the socioeconomic conditions at HAFB or MIT LL.

Implementation of the replacement facility would simply relocate personnel from one building on MIT LL / HAFB to another. Independent of other activities at HAFB, the proposed replacement facility is not expected to result in the creation of any new jobs. Similarly, the Preferred Alternative would not have any impact on the population or housing of MIT LL, HAFB, or the surrounding communities.

Under its instructions for the Environmental Impact Analysis Process (32 CFR Part 989), the Air Force must demonstrate compliance with Executive Order 12898, entitled *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, to determine the effects of federal programs, policies, and activities on minority and low income populations. Similarly, under EO 13045, entitled *Protection of Children from Environmental Health Risks and Safety Risks*, each federal agency must assess the environmental health risks and safety risks that may disproportionately affect children. In order for there to be a potential environmental justice impact, a unique low-income or minority population must be present, as well as a significant adverse impact. As described in Section 4.0, the proposed replacement facility is not expected to have significant human health or environmental impacts. Additionally the proposed building would be located within HAFB, considerably removed from unique populations with

respect to poverty and ethnicity. Access to the replacement facility would be restricted to credentialed professionals; no disproportionate environmental health or safety risks to children would occur. Therefore, the proposed project is consistent with the objectives of Executive Order 12898 and 13045.

4.12.2 No Action

The No Action alternative would not result in short or long term impacts related to population, employment, housing, or environmental justice. While MIT LL would perform some ongoing (and deferred) maintenance, there would be no substantial new construction, and the socioeconomic characteristics of MIT LL and HAFB would not be altered.

4.12.3 Preferred Alternative (C/J Lot)

No additional impacts are anticipated at the Preferred Alternative (C/J Lot) beyond what is described in the Common Effects subsection.

4.12.4 Alternative 2 (J Building)

No additional impacts are anticipated at Alternative 2 (J Building) beyond what is described in the Common Effects subsection.

4.12.5 Alternative 3 (Hillside at Gate 3A)

No additional impacts are anticipated at Alternative 3 (Hillside at Gate 3A) beyond what is described in the Common Effects subsection.

4.12.6 Alternative 4 (AFRL Open Field)

No additional impacts are anticipated at Alternative 4 (AFRL Open Field) beyond what is described in the Common Effects subsection.

4.13 SAFETY AND OCCUPATIONAL HEALTH

4.13.1 Common Effects

Construction activities would comply with all applicable federal, state, local, and applicable USAF regulatory safety standards. It is expected that the construction workers would be trained to identify and avoid safety hazards, such as those common to working around/with heavy equipment and electrically-powered handtools. A temporary chain link fence would be installed around the perimeter of the construction area, and only authorized personnel with appropriate personal protective equipment (PPE) would be allowed to entire the construction zone.

Operation of the proposed replacement facility would comply with MIT LL EHS policy to ensure that the activities conducted, as well as the products and services provided and used, are safe for MIT LL employees, other users, and the general public. In accordance with this policy, all individuals who engage in, or oversee, activities (e.g. work with potentially hazardous materials, equipment, or processes) that are regulated because of potential risks to the environment, health, or safety would continue to receive training appropriate to the regulated activity. To optimize safety and health in the workplace, personnel would continue to have access to all pertinent safety and health information related to any federal, state, MIT, applicable HAFB, or general-industry safety and health information, consistent with current practice at MIT LL. Personnel discovering an emergency situation are responsible for immediately reporting such status by the most expeditious means available as the conditions may dictate in order to protect personnel and minimize damage to equipment and to facilities. If an employee is injured while working, MIT Medical Department personnel, MIT LL Security, and the Hanscom Fire Department EMT responders would assist with medical first-aid treatment and coordinate medical transport to a local hospital or clinic, if necessary.

4.13.2 No Action

The No Action alternative would not result in any substantial new construction, although ongoing and deferred maintenance activities would occur. Operation of the existing laboratories would continue, including activities that occur in over-crowded conditions that are not ideal for health and safety. Ongoing research and development would continue to be conducted in accordance with MIT LL EHS Policy.

4.13.3 Preferred Alternative (C/J Lot)

No additional impacts are anticipated at the Preferred Alternative (C/J Lot) beyond what is described in the Common Effects subsection.

4.13.4 Alternative 2 (J Building)

No additional impacts are anticipated at Alternative 2 (J Building) beyond what is described in the Common Effects subsection.

4.13.5 Alternative 3 (Hillside at Gate 3A)

No additional impacts are anticipated at Alternative 3 (Hillside at Gate 3A) beyond what is described in the Common Effects subsection.

4.13.6 Alternative 4 (AFRL Open Field)

No additional impacts are anticipated at Alternative 4 (AFRL Open Field) beyond what is described in the Common Effects subsection.

4.14 AESTHETICS

4.14.1 Common Effects

During construction of the proposed replacement facility, the presence of cranes and other heavy construction equipment would alter a portion of the viewshed from nearby buildings within the MIT LL campus and HAFB. Short-term aesthetic impacts due to construction would be consistent with the developed nature of a military installation. It is not anticipated that construction equipment or the replacement facility, once constructed, would be visible from off-base locations such as the Minute Man National Historic Park or from any nearby residential properties.

4.14.2 No Action

The No Action alternative would result in the continued occupancy of the aging facilities on the MIT LL main campus. While some ongoing (and deferred) maintenance would occur, there generally would be little or no change to the exterior features of the existing buildings on HAFB. No short or long term impacts to the aesthetic character of MIT LL or HAFB would be expected.

4.14.3 Preferred Alternative (C/J Lot)

Existing features such as office buildings, laboratories, and parking facilities convey a functional aesthetic quality on MIT LL and HAFB. Although the presence of the proposed building at the Preferred Alternative (C/J Lot), in what is currently a parking lot, would alter the viewshed of the surrounding area by adding a new man-made feature, the aesthetic impact is not considered significant given the overall aesthetic character of MIT LL and HAFB. It is anticipated that the design of the replacement facility would have a steel frame, similar to many of the nearby buildings, yet have a modern style to reflect the state-of-the-art research to be conducted within its walls.

4.14.4 Alternative 2 (J Building)

The proposed replacement facility would slightly alter the viewshed of the surrounding area by adding a new man-made feature; however, the net change would not be significant, given that the adjacent J Building would be demolished. While the proposed replacement facility would have a larger footprint than the building to be torn down (J Building), the overall aesthetic character of the area would continue to reflect a mix of office buildings, laboratories, and parking facilities

that comprise the military installation. It is expected that the proposed replacement facility would reflect the modern style of newer buildings on the MIT LL campus (such as the South Lab), while incorporating architectural finishes enabling it to blend with the remainder of the developed landscape.

4.14.5 Alternative 3 (Hillside at Gate 3A)

The potential for aesthetic impact is greater at Alternative 3 (Hillside at Gate 3A), since the site is currently heavily wooded and has few developed features other than a walking path and small pavilion. The proposed modern design of the replacement facility would help to create a visual connection between the historic setting of MIT LL and its future in protecting our national interests. Around the perimeter of the replacement facility, a vegetated buffer would be established to create an aesthetically landscaped area that would transition to the more dense, undisturbed woodlot remaining on the hillside.

4.14.6 Alternative 4 (AFRL Open Field)

The proposed replacement facility would alter the viewshed of the surrounding area by adding a new three-dimensional, man-made feature in what is presently a flat grassy athletic field. However, the overall aesthetic character of the area would continue to reflect a mix of office buildings, laboratories, and other industrial uses that comprise the military installation. It is expected that the proposed replacement facility would reflect the modern style of newer buildings on HAFB (such as the Army National Guard Headquarters) and the MIT LL campus (such as the South Lab), while incorporating architectural finishes enabling it to blend with the remainder of the developed landscape on HAFB.

4.15 CUMULATIVE IMPACTS

Cumulative impacts are defined by the CEQ in 40 CFR Section 1508.7 as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." The potential environmental effect resulting from the incremental impacts of the Proposed Action, when added to other recent, ongoing, or proposed construction projects occurring on MIT LL and HAFB, is considered in the cumulative effects analysis in this section. As previously mentioned, construction for MIT LL's proposed replacement facility is anticipated to begin in Spring 2015 and be completed within approximately 2 years. Occupancy of the proposed replacement facility would be anticipated in the Spring of 2017.

Recently completed projects within the general vicinity of the proposed action on HAFB include Phase I of the replacement Massachusetts National Guard Joint Force Headquarters (JFHQ)

facility. Phase I comprised the construction of a 114,000 sf multi-story, masonry building and associated parking and stormwater detention. Phase II, currently under construction, comprises a 79,000 sf addition to the building. Located along Grenier Street and Randolph Road, construction of the JFHQ has resulted in similar environmental impacts as anticipated for the Proposed Action; the anticipated impacts associated with the JFHQ were described in an Environmental Assessment / FONSI completed in 2010 (HAFB, 2010e).

HAFB has a Capital Improvements Program (CIP) that identifies future development projects on the base and maintains an ongoing list of proposed new construction, renovation, and reuse of existing buildings (HAFB, 2012c). Those projects that have the potential to contribute to cumulative impacts, including projects that are either planned in the vicinity of MIT LL campus or the AFRL areas or are large construction projects that may potentially occur within the same timeframe as the proposed project on HAFB, are briefly described in this section.

- Mental Health Clinic Addition: The design phase for this project has been completed and construction is anticipated to begin in the near future. This project includes the construction of a single story 4,000 sf addition to existing Building 1900 located approximately 2,500 to 3,000 ft northwest of the MIT LL campus (and the project area for the replacement facility), along Eglin Street to the south of Vandenberg Drive. The existing Mental Health Clinic is currently located in Building 1217 (located north of Schilling Circle and to the southwest of Kirtland Street). Building 1217 may potentially be renovated, demolished and replaced with a new building, or converted to a parking lot (HAFB, 2003). The proposed project also includes site specific activities related to: environmental protection, utilities, pavements, restriping/reconfiguration of the existing parking lot, vehicular and pedestrian access from the existing parking lot, demolition of existing drives, and landscaping.

- Replace Middle School: The design phase for this project has been completed and construction is anticipated to begin in the near future. The project includes replacing the existing Hanscom Middle School with an 85,000 sf, two-story building along with associated site improvements, including: paving, parking, and utilities. The project site location contains the existing Middle School along with the existing Primary School and is located west of Marrett Street and approximately 3,000 ft west of the MIT LL campus.

- Air Force Enhanced Use Lease (EUL): In November 2011, the Air Force Real Property Agency (AFRPA) investigated the possibility of an EUL on HAFB (HAFB would lease land and facilities to private or public entities in exchange for cash or in-kind consideration). The AFRPA considered the parking lot between Upper and Lower AFRL or the area surrounding Building 1103 (located south of Wright Street and the MIT LL replacement facility project area) as a potential EUL site for a new office park development. Additional EUL possibilities included leasing the Lower AFRL buildings or

redeveloping the entire Upper AFRL site while demolishing the existing buildings as an in-kind consideration. However, there are currently no proposals to proceed with an EUL.

- Massachusetts Air National Guard (MA ANG) Combat Communications Relocation: The MA ANG had been considering a relocation of the MA ANG Communications enterprise, including approximately 265 guardsmen professionals from the 253rd Combat Communications Group (253 CCG) and the 267th Combat Communications Squadron (267 CBCS) at Otis ANG Base and the 212th Engineering Installation Squadron (212 EIS) in Milford, MA, to HAFB. The MA ANG had identified Buildings 1105A, 1105B and 1102F (all of which are located within the Lower AFRL campus) as potential buildings for relocation. However, this project is no longer being pursued (HAFB, 2013).

The following potential Military Construction (MILCON) projects are all projected to occur at least three to five years from now:

- MILCON #1 - Acquisition Management Facility Phase 2: This potential project would involve the second phase of replacing Building 1600 (which is 60,000 sf) located to the south of Barksdale Street and north of Arnold Street in the LCMC campus and approximately 3,500 to 4,000 ft to the northwest of the MIT LL campus (and project area for the replacement facility). Phase 1 of this project included replacing 40,000 sf with Building 1604 (to the west of Building 1600). For Phase 2, a 30,000 sf addition will be constructed. The environmental impacts of Phases 1 and 2, as well as the potential demolition of Bldg 1600, were described in an Environmental Assessment / FONSI completed in 2008 (HAFB, 2008).

- MILCON #5 - Education & Training Center: This potential project would involve replacing Building 1728 (22,000 sf of space is needed for this project) located north of Chennault Street, south of Robins Street, and approximately 2,500 ft to the northwest of the MIT LL campus and project area for the MIT LL replacement facility.

- MILCON #9 - Construct LCMC Headquarters Building: This potential project includes replacing Building 1606 (45,000 sf of space is needed for this project) located to the north of Vandenberg Drive and west of Eglin Street and approximately 3,500 to 4,000 ft to the northwest of the MIT LL campus and project area for the replacement facility.

- MILCON #10 - Construct School Age Children's Facility: This would include replacing Building 1999 (8,000 sf of space is needed) located west of Marrett Street and approximately 3,500 to 4,000 ft west of the MIT LL campus and project area for the replacement facility.

With respect to MIT LL, the Proposed Action is one step of a master planning effort whose goal is to consolidate similar functions and provide efficient state-of-the-art building spaces for its various research divisions. As a separate potential step towards this goal, MIT LL is currently evaluating a potential expansion (decompression of existing over-crowded facilities) into nearby buildings on the AFRL campus. Prior to occupancy of these buildings, MIT LL would conduct an Environmental Site Assessment, and would likely renovate the buildings' interiors. Depending on past use and the condition of the building, some remediation of environmental hazards (e.g. asbestos, lead-based paint, mold, etc.) would also likely be required prior to occupancy by MIT LL. Heating and cooling needs for the buildings within AFRL are currently met by the HAFB CHP; MIT LL does not envision changing the heating/cooling configuration at this time (i.e. heating load is already factored into HAFB CHP's operations; no additional boilers would be installed).

In consideration of potential cumulative impacts, each of the projects listed above has some potential to result in adverse impacts, consistent with typical construction projects. Most of these other projects comprise development, or redevelopment within previously disturbed portions of HAFB, with the exception of the JFHQ facility which, like Alternative 3 (Hillside at Gate 3A), has proportionately greater impacts to natural resources (primarily associated with tree clearing). However, it is not anticipated that the combination of the construction of the JFHQ, the MIT LL replacement facility [at the Preferred Alternative (C/J Lot)], and the HAFB projects listed above would result in significant cumulative impacts regarding the loss of natural resources or the conversion of land use. Most of the MILCON and CIP future development projects (with the exception of the EUL) do not occur within areas of archaeological sensitivity or proximate to historic districts, and thus would not contribute to cumulative impacts. HAFB is currently developing a Programmatic Agreement (PA) with MHC to address potential cumulative effects of maintenance, construction, and/or demolition activities within the AFCRL Historic District.

The Proposed Action, combined with other ongoing or proposed activities at HAFB, has the potential to result in minor short-term increases in traffic, noise levels, emissions, and solid waste generation; however, the effects would generally be limited to the construction timeframe of each project and be proportional to the size of the building being constructed or renovated. Overall, the Proposed Action would not result in, or contribute to, significant negative cumulative impacts to the resources on HAFB or in the region.

Additionally, MIT LL has initiated conceptual planning for the Phase 2 Replacement Facilities. At this time, the preferred location for Phase 2 has not been determined, but it is anticipated to be selected from the remaining alternatives evaluated, but not selected, for Phase 1, or may include a parcel in Upper AFRL suggested by HAFB. When sufficient project detail has been developed, MIT LL will prepare a separate NEPA document (Environmental Assessment) evaluating the potential effects of the Phase 2 development, including a cumulative assessment of Phase 1 and Phase 2. If Phase 2 were to be proposed on the Hillside at Gate 3A and thus result in the clearing of trees, MIT LL recognizes that the cumulative effect (e.g. JFHQ + MIT

LL Phase 2) could be significant. In this event, MIT LL anticipates providing appropriate mitigation, in coordination with HAFB, to offset the impact such that the project would qualify for a “mitigated FONSI” – A Finding of No Significant Impact concluding that the project’s adverse impacts would be reduced to a less-than-significant level via mitigation conditions.

4.16 UNAVOIDABLE ADVERSE IMPACTS

The Proposed Action would result in some unavoidable short-term and long-term impacts. The anticipated unavoidable adverse impacts associated with the Preferred Alternative (C/J Lot), if any, are described below for each environmental resource. These potential impacts are generally minor and would be further minimized through the implementation of best management practices described in Section 4.17.

Topography, Geology, and Soils: Construction activities, including connection of the proposed facility to nearby existing utilities (or relocation of existing utilities), are not anticipated to alter soils, as soils in the vicinity of the Preferred Alternative (C/J Lot) are characterized as Urban Land. In addition, the presence of the replacement facility at the Preferred Alternative (C/J Lot) is not expected to result in a long-term change in topography.

Land Use: Short-term impacts associated with construction activities would include temporary disruption to adjacent land uses due to elevated noise levels, increased dust, interference with roadway access, and visual effects. No long-term change in land use designation (Research and Development) would result from the presence of the replacement facility at the Preferred Alternative (C/J Lot).

Water Resources: Construction activities would result in the disturbance of more than one acre; therefore, MIT LL will obtain and comply with the NPDES General Permit for Stormwater Discharges from Construction Activities. Construction of the replacement facility may intersect the groundwater table due to seasonally high groundwater levels throughout the base. Therefore, dewatering may be necessary, and the construction contractor will be required to include provisions for dewatering. MIT LL’s design of the replacement facility would comply with HAFB’s stormwater runoff requirements, pursuant to the Clean Water Act and the impaired status of the Shawsheen River.

Biological Resources: Construction activities, including connection of the proposed building to nearby existing utilities (or relocation of existing utilities), would require grading and excavation that would result in the loss of existing vegetation; these impacts would be short-term. Construction activities may also displace birds and small mammals that utilize the vegetated areas for foraging or nesting. However, the removal of vegetation is not subject to the MA Wetlands Protection Act (i.e. the proposed construction is not located within proximity to wetlands).

Cultural Resources: Construction of the Preferred Alternative (C/J Lot) is not anticipated to have an adverse impact on archaeological resources. Similarly, the presence of the replacement facility at the Preferred Alternative (C/J Lot) is not anticipated to have an adverse effect on the AFCRL Historic District to the south.

Air Quality: Short-term localized air quality impacts may occur due to construction of the replacement facility, as construction could generate fugitive dust. Additionally, all construction vehicles and some equipment would produce engine emissions, including ozone precursors, which could temporarily affect air quality.

The proposed replacement facility would need to be heated, cooled, and ventilated; backup power would need to be provided. Each of these activities could represent a new source of (or an increase in) air emissions, thereby adversely impacting air quality. If the new building is to be heated by the HAFB Central Heat Plant, the impact on air quality would not be meaningfully distinguished from the overall emissions of the CHP. If the heating is decentralized, operation of the replacement facility at the Preferred Alternative (C/J Lot) is expected to require stand-alone boiler(s) with an input rating of approximately 15,600,000 BTU/hour. The anticipated annual emissions from the boiler(s) are anticipated to be more than one ton per year of NO_x and may exceed permitting thresholds established by the Massachusetts Air Pollution Control regulations (310 CMR 7.02).

The proposed facility would have standby diesel-powered generator(s). The generator(s) is anticipated to be capable of supplying 1.0 MW for the Preferred Alternative (C/J Lot). The Massachusetts Air Pollution Control regulations provide an exemption for standby generators less than 1 MW [310 CMR 7.26(42)]. Since MIT LL presently has a Comprehensive Air Plan that addresses the entire MIT LL campus, it is anticipated that an amendment would be filed to obtain MassDEP's approval of the proposed generators, if necessary.

Noise: Construction activities would result in a short-term increase in noise levels within the vicinity of construction. While the overall duration of construction is expected to be approximately 2 years, the highest construction noise levels are expected to occur during the first phases of construction, when sites are cleared and foundations excavated. These elevated noise levels are not likely to significantly disrupt the activities in nearby office and laboratory buildings.

Infrastructure: Construction activities would result in a short-term increase in demand for water supply, sewage treatment, and electricity. Some existing utilities may need to be relocated prior to construction. Construction activities may result in short-term impacts to the storm drainage system due to ground disturbance and temporarily exposed soils that may be carried to the drainage system during heavy storms.

New utilities would need to be installed to connect the replacement facility to existing distribution/service lines. The operation of the proposed replacement facility is anticipated to increase water demand due to the general functions of the buildings; however, operation would not increase demand for potable water at HAFB beyond the available supply. MIT LL would need to amend its MWRA Sewer Discharge Permit to include the new locations from which wastewater would be generated and modify the sampling plan accordingly. The operation of the proposed replacement facility would increase the demand for, and use of, electricity at MIT LL; however, HAFB's electrical demand is well below the capacity of the transmission lines.

Should final design of the replacement facility include a requirement for natural gas, new service laterals would be installed to provide service to the building. While the HAFB natural gas distribution system currently has capacity limitations, these issues are being addressed by National Grid and HAFB. The use of natural gas within the replacement facility would not be expected to increase demand for natural gas at HAFB beyond the anticipated capacity of the distribution system (following upgrades by National Grid and HAFB, as part of a separate action).

If the proposed replacement facility were to obtain heat (via steam) from the HAFB CHP, the estimated maximum demand would be 8,100 to 13,000 pounds per hour. While some improvements to CHP efficiency and distribution system efficiency have been made in the past decade, there has been no increase in approved capacity. Without a reduction in demand from other users, or further reductions in heat losses from the existing distribution network, connection of the MIT LL replacement facility to the HAFB CHP could increase the number of hours/days when the HAFB CHP must operate all four boilers simultaneously, without any standby capacity. As a result, MIT LL is proposing to provide heat and hot water to the replacement facility via stand-alone boilers to be installed in the new building. If MIT LL utilizes stand-alone boilers, there would be no impact on the HAFB CHP.

With regard to cooling, it is anticipated that the proposed replacement facility would be connected to the MIT LL CWP, where incremental capacity can be added without significant impact to existing infrastructure. Alternately, MIT LL is also considering the use of stand-alone chillers. If stand-alone units are employed, there would not be a need to increase the capacity at the MIT LL CWP.

Traffic: Impacts to transportation systems at/near HAFB and MIT LL during construction would be minimal. Increased activity in the vicinity of construction activities, including connection of new facilities to existing utilities, may temporarily disrupt local traffic on HAFB and/or MIT LL; however no impact to off-base roads is anticipated.

Construction of the replacement facility at the Preferred Alternative (C/J Lot) location would result in the permanent displacement of approximately 205 existing parking spaces near J

Building. MIT LL recently conducted a parking study to evaluate the parking situation in the vicinity of the MIT LL campus; this analysis concluded there is sufficient parking capacity, although not always in the most convenient proximity, within adjoining portions of HAFB.

Solid Wastes and Hazardous Materials: Construction activities would generate solid waste, primarily associated with packaging of construction materials. During construction, hazardous materials and waste would likely be used and generated, including: equipment fuel, engine oil, hydraulic oil, grease, and other equipment operation and maintenance material.

Emergency generators with associated aboveground diesel fuel storage tanks would be installed outside the proposed building. The ASTs would require permits from HAFB. Operation of the emergency generators would result in periodic generation of waste oil/lubricants; however, substantial quantities are not anticipated.

Socioeconomic Conditions: Construction activities would generate a small benefit for the construction industry, as there would be a corresponding short-term increase in the demand for skilled workers and construction materials. No adverse impacts are anticipated.

Safety and Occupational Heath: Construction activities would comply with all applicable federal, state, local, and applicable USAF regulatory safety standards. Operation of the proposed replacement facility would comply with MIT LL EHS policy to ensure that the activities conducted are safe. Moreover the proposed replacement facility would allow MIT LL to reduce operations in out-dated, over-crowded space, thereby improving life safety conditions for its employees. No adverse safety and occupational health impacts are anticipated.

Aesthetics: During construction activities, the presence of cranes and other heavy construction equipment would alter a portion of the viewshed from nearby buildings within the MIT LL campus and HAFB. Short-term aesthetic impacts due to construction would be consistent with the developed nature of a military installation.

The proposed replacement facility would alter the viewshed of the surrounding area by adding new three-dimensional, man-made features. However, the overall aesthetic character of the area would continue to reflect a mix of office buildings, laboratories, and other industrial uses that comprise the military installation.

4.17 BEST MANAGEMENT PRACTICES TO MITIGATE IMPACTS

Most of the impacts that may occur during construction and operation of the replacement facility are minor in nature. With implementation of the following best management practices and mitigation measures, the potential for adverse impact is further reduced.

Topography, Geology, and Soils: Construction activities would proceed in accordance with HAFB BMPs to stabilize soils and minimize erosion.

Land Use: During construction activities, dust would be controlled on-site by using water to wet down disturbed areas, covering trucks and stockpiled materials with tarps, and re-vegetating disturbed land as soon as possible to minimize impacts to nearby facilities. Mufflers would be used on construction equipment and vehicles. Notification of the proposed construction must be provided to FAA, as the Preferred Alternative (C/J Lot) would penetrate the imaginary surface extending at a slope of 100 to 1 for a horizontal distance of 20,000 feet from the nearest runway.

While a portion of the Preferred Alternative (C/J Lot) may fall within the Line of Sight angle for laser/communication equipment originating within either the MIT LL main campus (e.g. Bldgs 1302B/1302C) or its Katahdin Hill facilities, it is expected that any potential LOS conflicts can be satisfactorily managed, with one option being to relocate the laser/communication equipment, potentially into the proposed replacement facility.

Water Resources: All construction activities would be conducted in accordance with best management practices to prevent adverse effects to the receiving water (i.e. Shawsheen River) into which the stormwater system discharges. MIT LL's design of the replacement facility would implement stormwater structural BMPs to reduce runoff during wet weather events and retain or infiltrate water on-site (or nearby) in accordance with HAFB's drainage requirements. An extensive stormwater management system would be implemented to capture and infiltrate the run-off, such that the post-construction rate of groundwater recharge would exceed that which presently occurs.

Biological Resources: Following construction, a landscaped buffer would be created around the perimeter of the new buildings, to help mitigate the vegetation lost during construction. All vegetated areas disturbed outside of the construction area, including utility trenches in unpaved areas, would be seeded upon project completion in order to restore the vegetative cover of the area and promote infiltration. The landscaping plan would favor native species and exclude non-native species considered to be weedy or invasive by the United States Department of Agriculture.

Cultural Resources: It is anticipated that the proposed building would be designed, constructed, and operated to minimize impacts to historic resources. In the event that cultural artifacts are uncovered during construction, excavation would be suspended to allow for coordination with MHC and HAFB Environmental personnel.

Air: All equipment and vehicles used during construction would be maintained in good operating condition, and idling would be limited so that emissions are minimized, thus reducing air quality impacts. Dust would be controlled on-site by using water to wet down disturbed areas, covering trucks and stockpiled materials with tarps, and re-vegetating disturbed land as soon as possible to minimize impacts.

Noise: To minimize noise impacts during construction, mufflers would be used on construction equipment and vehicles. Any operational noise levels generated would be maintained at a level consistent with current OSHA regulations as specified in CFR Title 29, Part 1910.

Infrastructure: Sedimentation and erosion control measures, such as the use of temporary drainage swales, temporary diversion dikes, sediment traps, and/or compost filter socks or silt fence, would be implemented prior to and during construction to reduce the potential for impacts to the storm drainage system due to ground disturbance and temporarily exposed soils that may be carried to the drainage system during heavy storms. The design of the project would include stormwater BMPs (such as a subsurface infiltration system or a retention basin) to reduce runoff during a storm and retain or infiltrate water on-site in accordance with HAFB's drainage requirements.

The design of the proposed replacement facility is anticipated to incorporate energy conservation technologies, such as high efficiency lighting and/or motion-activated sensors/timers for room lighting to help minimize the demand for and use of electricity.

Traffic: If necessary, traffic management measures would be developed to facilitate vehicular flow and pedestrian access as construction vehicles cross through the traveled portions of the base and the MIT LL campus. A portion of the existing parking spaces in the C/J Lot may be designated, via signage, as reserved for use by Hanscom AFB customers only, to minimize potential parking impacts on visitors to Building 1305 (Brown Building).

Solid Wastes and Hazardous Materials: To the extent practicable, construction would utilize reused or recycled materials to help lessen the impact associated with new construction. All hazardous materials used during construction would be handled and disposed of in accordance with MIT LL policies and protocols and all applicable state and federal regulations.

Safety and Occupational Heath: Construction activities would comply with all applicable federal, state, local, and applicable USAF regulatory safety standards; it is expected that construction workers would be trained to identify and avoid safety hazards. During construction activities, a temporary chain link fence would be installed around the perimeter of construction areas, and only authorized personnel with appropriate personal protective equipment would be allowed to enter construction zones.

Operation of the proposed replacement facility would comply with MIT LL EHS policy to promote safety for MIT LL employees, other users, and the general public. In accordance with this policy, all individuals who engage in, or oversee, activities that are regulated because of potential risks to the environment, health, or safety would continue to receive training appropriate to the regulated activity. Personnel discovering an emergency situation are responsible for immediately reporting such status

by the most expeditious means available as the conditions may dictate in order to protect personnel and minimize damage to equipment and to facilities.

Aesthetics: It is expected that the proposed building would reflect the modern style of newer buildings on HAFB (such as the Army National Guard Headquarters) and the MIT LL campus (such as the South Lab), while incorporating architectural finishes that minimize aesthetic impacts and blend with the remainder of the developed landscape on HAFB.

4.18 RELATIONSHIP BETWEEN SHORT-TERM USES AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

It is not anticipated that the short-term impacts associated with construction of the proposed replacement facility, as described in previous sections would result in long-term compromises of productivity. Implementation of the Proposed Action is part of a broader objective to build replacement facilities for MIT LL to support continued research and development in a manner that is both more cost effective and ensures compliance with current industry standards. If MIT LL were to not undertake the Proposed Action, the result would be continued occupancy in existing buildings that will require significant investment (even for deferred maintenance), with no inherent functional improvements to support state-of-the-art research. The Proposed Action would provide new state-of-the-art facilities that would house a research division with heavy laboratory functions. Therefore, long-term productivity would be increased by implementation of the Proposed Action.

4.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that the use of those resources have on future generations. An irreversible effect could result from the use of resources that cannot be replaced within a reasonable time (e.g. energy and minerals). An irretrievable effect could result from the loss of resources that cannot be restored as a result of the Proposed Action. Irretrievable resource commitments involve the loss in value of an affected resource (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site). The Proposed Action would constitute an irreversible or irretrievable commitment of non-renewable or depletable resources, for the materials, time, money, and energy expended during activities implementing the Proposed Action.

Construction and operation of the new building would require the consumption of fossil fuel and energy. Construction requires equipment that would use fuel, either gasoline or diesel fuel, to operate. During operation, the facility would require fossil fuels to generate the energy for heating, cooling and ventilation. However, the replacement facility would be built with modern equipment that incorporates greater efficiencies than those achieved at the existing laboratory facilities.

The Proposed Action requires the manufacturing of materials. Some of these materials would not be recycled at the end of the project lifetime, thus becoming an irreversible and irretrievable commitment of resources. However, no supplies are considered scarce and would not limit other unrelated construction activities in the region. The packaging of construction materials, as well as other waste generated during construction and operation, would result in an irreversible and irretrievable allocation of landfill or other solid waste disposal capacity.

5.0 LIST OF PREPARERS

AECOM prepared this document to fulfill the requirements of the NEPA for the Proposed Action of constructing the replacement facility at HAFB in Massachusetts. Other entities that provided information on an as-needed basis included MIT LL and HAFB Environmental Management personnel. The following persons authored and provided direct oversight for the preparation of this EA (MIT LL Facilities Replacement on HAFB Phase 1):

MANAGEMENT

Shreve-Gibb, Betsy. M.R.P. Urban and Regional Planner. AECOM. As Senior Project Manager responsible for NEPA compliance, with extensive experience preparing environmental assessments and permits, provided technical review and oversight for preparation of all sections of the EA.

TASK LEADER

Petras, James. B.S. Biology. AECOM. As a Project Manager with expertise in preparing environmental assessments and impact reports for federal, municipal, and commercial entities, provided review of the EA.

CONTRIBUTING AUTHORS

Pietro, Lisa. M.S. Geography. AECOM. As an Environmental Scientist/Permitting Specialist with diverse experience in wetland resource area delineations, ecological site evaluations, GIS, NEPA compliance, and permitting, authored and revised portions of the EA and prepared maps/figures.

Hunt, Jessica. M.S. Natural Resources: Water Resources. AECOM. As a Senior Environmental Scientist/Environmental Impact Specialist with diverse experience in GIS, natural resource protection, watershed issues, and the preparation of technical and scientific documents, prepared maps/figures, and authored portions of the EA.

Coolidge, Brian. B.S. Cartography. AECOM. As a GIS/CADD Specialist with expertise in GIS database development, map generation, and application development, mobile data collection and integration, prepared maps/figures for the EA.

6.0 LIST OF PERSONS CONSULTED AND/OR PROVIDED COPIES

6.1 MIT AND HAFB

The following MIT (including MIT LL) and HAFB personnel were consulted during the preparation of this Environmental Assessment:

MIT (including MIT LL)
Margaret Brill, MIT, General Counsel's Office
David DeMoura, MIT LL, Chief Engineer, Facilities Service Department
Gretchen McGill, MIT LL, Senior Program Manager, Capital Projects Office
Mike Menadue, MIT LL, Manager, Capital Projects Office
Susan Newsham, MIT LL, Technology and Contracts Office
Kriss Pettersen, MIT LL, Senior Program Manager, Capital Projects Office
Bill Ryan, MIT LL, Environmental, Health, & Safety Manager
Paula Sullivan, MIT LL, Environmental Compliance, Facilities Service Department

HAFB
Nick Bonard, HAFB, 66 ABG/CEK, Programmer / Base Planner
Greg Cravedi, HAFB, 66 ABG/CEG, Natural/Cultural Resources Specialist
Michael Lynch, HAFB, 66 ABG/CE, Capital Asset Manager
James Maravelias, HAFB, 66 ABG/CEK, EIAP Coordinator and Hazardous Waste Specialist
Don Morris, HAFB, 66 ABG/CEG, Environmental Director
Sean Shayan, HAFB, 66 ABG/CEG, Mechanical Engineer
Charles Strickland, 66 ABG/CE, Environmental Engineer
Patterson White, 66 ABG/CEK, HAFB Civil Engineering – Geobase Manager

6.2 PUBLIC REVIEW

The public was offered a 30-day period to comment on this EA (MIT LL Facilities Replacement on HAFB Phase 1). A public notice was published in the Hansconian, the Lexington Minuteman, the Lincoln Journal, the Bedford Minuteman, and the Concord Journal on __________, and the EA was available for public review at the HAFB Library and at the Lexington, Lincoln, Bedford, and Concord public libraries.

7.0 REFERENCES

AECOM. 2013a. Findings of Tree Survey – "Walking Path" (potential future site of Southwest Lab). Technical Memorandum. January 2013.

AECOM. 2013b. Stormwater Proof of Concept Study. February 2013.

AECOM. 2013c. Tree Mitigation Strategy. January 2013.

AECOM. 2013d. MIT Lincoln Laboratory Parking Study - Technical Memo / Data Collection Summary. January 2013.

Council on Environmental Quality (CEQ). 1978. *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*. 40 CFR Parts 1500-1508. November 28, 1978 (and as updated through July 1, 1998).

CEQ. 2010. *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*. http://ceq.hss.doe.gov/nepa/regs/Consideration_of_Effects_of_GHG_Draft_NEPA_Guidance_FINAL_02182010.pdf

Executive Office of Labor and Workforce Development (EOLWD). 2011. Current Employment Statistics. Accessible at: http://www.mass.gov/?pageID=elwdterminal&L=4&L0=Home&L1=Government&L2=EOLWD+Data+and+Statistics&L3=Labor+Market+Information&sid=Elwd&b=terminalcontent&f=dua_economic_data_employment_jobs&csid=Elwd. Website Accessed August 2011.

Federal Highway Administration (FHWA). 2002. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects.

GEI Consultants. 2012. Preliminary Memorandum, West Lab Project, MIT Lincoln Laboratory. December 21, 2012.

Hanscom Air Force Base (HAFB). 2003. General Plan Update. Hanscom Air Force Base, Massachusetts. November 2003.

HAFB. 2005. Fact Sheet – Hanscom AFB. RE: economic impact on the surround community. Access at: http://www.hanscom.af.mil/library/factsheets/factsheet.asp?id=7493

HAFB. 2008. Draft Environmental Assessment. Replacement Acquisition Management Facility. Prepared by Metcalf & Eddy | AECOM. April 2008.

HAFB. 2010a. Integrated Natural Resources Management Plan for Hanscom AFB. May 18, 2010.

HAFB. 2010b. Hanscom AFB Integrated Cultural Resources Management Plan. Prepared by John Milner Associates, Inc. and updated by 66 ABG/CEV for Hanscom AFB. December 2010.

HAFB. 2010c. Draft Evaluation Report, Volume II Hanscom Air Force Base, One Cleanup Program, AFCEE Support. Contract No. W912BV-06-D-2014. Prepared for U.S. Army Corps of Engineers. Prepared by URS Group, Inc. June 2010.

HAFB. 2010d. Hanscom Air Force Base – National Register of Historic Places Eligibility Evaluations. Prepared by PAL. May 2010.

HAFB. 2010e. Final Environmental Assessment – Replacement Joint Force Headquarters Building, Hanscom AFB. Prepared by URS Corporation. January 22, 2010.

HAFB. 2011. Personal Communication between HAFB (S. Shayan) and AECOM (J. Petras), RE: HAFB Central Heat Plant.

HAFB. 2012a. Letter to the Massachusetts Historical Commission (Brona Simon) from HAFB (Donald Morris) regarding Air Force Research Laboratory (AFRL) Katahdin Hill. January 13, 2012.

HAFB. 2012b. U.S. Air Force Fact Sheet, Hanscom Air Force Base. Posted December 2012. Available at: http://www.hanscom.af.mil/library/factsheets/factsheet.asp?id=7493. Website accessed January 2013.

HAFB. 2012c. Personal Communication between HAFB Base Planner (N. Bonard) and AECOM (J. Petras), RE: Cumulative Impacts.

HAFB. 2013. Personal Communication between HAFB Capital Asset Manager (M. Lynch) and AECOM (J. Petras), RE: MA ANG Combat Communications Relocation. April 29, 2013.

King, Marsha K.; Edna Feighner, and Duncan Ritchie. 1992. Archaeological Reconnaissance Survey of Hanscom AFB – Bedford, Concord, Lexington, and Lincoln, Massachusetts.

Massachusetts Department of Environmental Protection (MassDEP). 2002. Bacteria TMDL for the Shawsheen River Basin. Report MA83-01-2002-24. http://www.mass.gov/dep/water/resources/shawshee.pdf

MassDEP. 2003. Draft Storm Water Pollutant Total Maximum Daily Load for Headwaters of the Shawsheen River: DEP, DWM TMDL Report MA83-08-2003-01. June 9, 2003. http://www.mass.gov/dep/water/resources/shawhead.pdf

MassDEP. 2010. Massachusetts Year 2010 Integrated List of Waters; Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Prepared by the Division of Watershed Management, Watershed Planning Program. April 2010.

MassDEP. 2011a. Commonwealth of Massachusetts 2010 Air Quality Report. MassDEP Air Assessment Branch. June 2011. http://www.mass.gov/dep/air/priorities/10aqrpt.pdf

MassDEP. 2011b. DEP Water Supply Protection Areas. MassGIS Interactive Map Viewer. Available online at: http://maps.massgis.state.ma.us/WSPA/viewer.htm. Website accessed August 2011.

Massachusetts Geographic Information Systems (MassGIS). 2011. Watersheds, Subwatersheds, and Surface Water Protection Zones. http://www.mass.gov/mgis/swp.htm.

Massachusetts Historical Commission (MHC). 2012a. Letter to HAFB (Donald Morris) regarding Air Force Research Laboratory (AFRL) Katahdin Hill. January 17, 2012.

MHC. 2012b. Letter to AECOM (James Petras) regarding Massachusetts Institute of Technology Lincoln Laboratory (MIT LL) New Facilities. March 14, 2012.

MHC, 2013. Letter to Hanscom AFB (Donald Morris) regarding Massachusetts Institute of Technology Lincoln Laboratory New Facilities, Southwest Lab Project. MHC #RC.52118. July 5, 2013.

Massachusetts Institute of Technology (MIT). 2013. MIT Facts 2013: Lincoln Laboratory. Available online at: http://web.mit.edu/facts/lincoln.html. Website accessed January 2013.

Massachusetts Institute of Technology Lincoln Laboratory (MIT LL). 1988. Preliminary Investigation – Proposed Expansion (MIT Laboratory) – Subsurface Exploration Plan. Prepared by Haley & Aldrich, April 1988.

MIT LL. 2008. MIT Lincoln Lab Facility Condition Assessment. Prepared by Facility Engineering Associates (FEA). October 2008.

MIT LL. 2009. J Building – Lead Based Paint Information, September 2009.

MIT LL. 2010. MIT Lincoln Laboratory – Conceptual Site Master Plan Study. Prepared by Payette. August 2010.

MIT LL. 2011a. Bike-to-Work Team pedals to grand prize award in MassCommuter Challenge. http://www.ll.mit.edu/news/awards.html

MIT LL. 2011b. Environmental, Health, and Safety Overview. Personal communication between MIT LL (W. Ryan) and AECOM (J. Petras).

MIT LL. 2011c. Annual Report 2011. MIT LL Communications and Community Outreach Office.

MIT LL. 2012. SARA Tier I/II Report and Chemical Inventory.

MIT LL. 2013. Baseline Parking Memo, Data Collection Summary. January 2013.

MIT LL. 2013b. Annual Report for Massachusetts Institute of Technology Lincoln Laboratory (re: Permit Emissions), prepared by Woodard & Curran. 25 January 2013.

MIT LL. 2013c. Energy Master Plan Addendum – Working Draft. Prepared by Sebesta Blomberg. March 6, 2013.

Massport. 2011. L.G. Hanscom Field 2010 Annual Noise Report. Prepared by Massachusetts Port Authority. Submitted to Hanscom Field Advisory Committee. November 2011.

Natural Heritage Endangered Species Program (NHESP). 2008. Priority Habitat & Estimated Habitat Viewer. Available online at: http://maps.massgis.state.ma.us/PRI_EST_HAB_TEST/viewer.htm. Website accessed August 2011.

Parsons Engineering Science (Parsons). 1998. Final: Phase I Archaeological Survey, Hanscom Air Force Base, Massachusetts. Prepared for Air Force Center for Environmental Excellence, Brooks AFB, Texas and Hanscom AFB, Massachusetts.

Public Archaeology Laboratory (PAL). 2003. Architectural Building and Inventory Survey. June 2003.

PAL. 2013. Technical Memorandum: Intensive Archaeological Survey. January 2013.

Sacramento Metropolitan Air Quality Management District (SMAQMD). 1991. SMAQMD 1991 survey. Sacramento, CA.

United States Air Force (USAF). 1999. Air Installation Compatible Use Zone (AICUZ) Program Manager's Guide, Air Force Handbook 32-7084. March 1, 1999.

United States Army Corps of Engineers (USACE). 2000. Hot-Mix Asphalt Paving Handbook.

U.S. Census Bureau. 2011. American FactFinder: Census 2010 Demographic Profile Data and 2005-2009 American Community Survey 5-Year Estimates Data Profiles. Available online at: http://factfinder.census.gov/home/saff/main.html?_lang=en and http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. Website accessed August 2011.

United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2011. Web Soil Survey: Soil Maps-Middlesex County, Massachusetts. Available online at: http://websoilsurvey.nrcs.usda.gov/. Website accessed October 2011.

United States Environmental Protection Agency (USEPA). 1991. Nonroad Engine and Vehicle Emission Study-Report (EPA-21A-2001). November 1991.

US EPA. 2001. Emission Inventory Improvement Program (EIIP), Technical Report Series Volume III: Area Sources and Area Source Method Abstracts, Chapter 17, Asphalt Paving. January 2001.

USEPA. 2004. Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression-Ignition (EPA420-P-04-009). April 2004.

USEPA. 2005. Exhaust Emission Factors for Nonroad Engine Modeling: Spark-Ignition (EPA420-R-05-019). December 2005.

USEPA. 2009. Fact Sheet: Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act. December 2009. Available at: http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_factsht.pdf. Website accessed, February 2012.

USEPA. 2010. Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling (EPA-420-R-10-016). July 2010.

USEPA. 2011. Statement by the President on the Ozone National Ambient Air Quality Standards. Issued by the White House, Office of the Press Secretary on September 2, 2011.

APPENDIX A: AGENCY CORRESPONDENCE

Note: At the time agency co-ordination was initiated, the alternatives were referred to with slightly different names, as explained below.

Nomenclature at the Time of Agency Co-ordination (2011-2012)	Present Nomenclature (2013)	Comment
West Lab	C/J Lot (Preferred Alternative)	Split into two separate alternatives. Names changed to reflect existing features, rather than proposed facility.
Southwest Lab	Hillside at Gate 3A (Alternative 3)	
J Building (Alternative 2)	J Building (Alternative 2)	unchanged
Lower AFRL Parking Lot (Alternative 3)	N/A	Alternative dropped from consideration, per request from HAFB and JFHQ
Lower AFRL Soccer Field (Alternative 4)	AFRL Open Field (Alternative 4)	Renamed to more accurately reflect existing condition

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

REF: Replacement Laboratory Facilities
Hanscom Air Force Base, MA

December 15, 2011

Mr. James Petras
AECOM
701 Edgewater Drive
Wakefield, MA 01880

Dear Mr. Petras:

We received your letter (enclosed) requesting an endangered species review in regard to the proposed project identified above.

The New England Field Office has developed measures to streamline the endangered species consultation process and other requests for technical assistance. The information you have requested is available on our website at:

http://www.fws.gov/newengland/endangeredspec-consultation.htm

Please review these streamlining measures. We are confident they will adequately address your request. For assistance in navigating the website, please contact Mr. Anthony Tur of this office at 603-223-2541.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

Enclosure

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

November 30, 2011

James Petras
AECOM
701 Edgewater Drive
Wakefield MA 01880

RE: Project Location: Hanscom Airforce Base
Project Description: Replacement Laboratory Facilities - Massachusetts Institute of Technology Lincoln Laboratory
NHESP Tracking No.: 11-30321

Dear Mr. Petras:

Thank you for submitting information regarding your project to the Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries & Wildlife.

Based on a review of the information that was provided, including "*Figure 2. Alternative Sites Proposed Replacement Laboratory Facilities on Hanscom AFB MIT Lincoln Laboratory*" and the information that is currently contained in our database, the NHESP has determined that this project, as currently proposed, **does not occur within Estimated Habitat of Rare Wildlife or Priority Habitat** as indicated in the *Massachusetts Natural Heritage Atlas* (13th Edition). Therefore, the project is not required to be reviewed for compliance with the rare wildlife species section of the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.37, 10.59 & 10.58(4)(b)) or the MA Endangered Species Act Regulations (321 CMR 10.18). Any additional work beyond that shown on the site plans may require a filing with the NHESP.

Please note that this determination addresses only the matter of **rare** wildlife habitat and does not pertain to other wildlife habitat issues that may be pertinent to the proposed project. If you have any questions regarding this letter please contact Amy Coman-Hoenig, Endangered Species Review Assistant, at (508) 389-6364.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D.
Assistant Director

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

March 14, 2012

James Petras
Environmental Scientist
AECOM
701 Edgewater Drive
Wakefield, MA 01880

RE: Massachusetts Institute of Technology Lincoln Laboratory New Facilities, Hanscom Air Force Base, Lexington, MA. MHC #RC.52118.

Dear Mr. Petras:

Staff of the Massachusetts Historical Commission (MHC), office of the State Historic Preservation Officer, have reviewed the information that you submitted for the project referenced above.

This project proposes the construction of new laboratory facility(s) on Hanscom Air Force Base (AFB). The new multi-story buildings would include laboratory, office, and administrative space. Four alternatives have been identified, including construction of two separate buildings that will provide the necessary floor space; the West Lab and Southwest Lab (Preferred Alternative); demolition and reuse of a parcel containing the existing J Building (Alternative 2); Lower Air Force Research Laboratory (AFRL) Parking Lot (Alternative 3); and Lower AFRL Soccer Field (Alternative 4).

Some of the alternatives presented would result in new construction within the proposed boundaries of the AFRL Katahdin Hill/Phillips Lab area. The U.S. Air Force and the MHC have previously agreed that the Air Force Research Lab Katahdin Hill/Phillips Lab area meets the criteria of eligibility for listing in the National Register of Historic Places. Alternative 2 would require demolition of the existing J Building, which is not included within the boundaries of the potential historic district. The MHC looks forward to continued consultation as project plans progress, including review of the proposed design of the new construction if it is to be placed within the boundaries of the AFRL Katahdin Hill/Philips Lab area.

The location of the preferred alternative of the proposed Southwest Lab is an archaeologically sensitive area. The MHC requests that an intensive (locational) archaeological survey (950 CMR 70) be conducted for the maximum boundaries of the area required to be impacted to construct that aspect of the project. The survey should be conducted by a qualified archaeological consulting firm with previous, relevant experience in the archaeology of New England, which should apply for a State Archaeologist's field investigation permit (950 CMR 70). The results of the survey will be reviewed in consultation to consider alternatives to avoid or mitigate any project-related adverse effects to any significant archaeological resources that may be present.

Please provide the project information that you submitted to the MHC to the following potentially interested parties (mailing addresses available upon request to the MHC), for their review and comment. A copy of any written comments from these parties should be provided to the MHC:

The Bedford, Concord, Lexington, and Lincoln Historical Commissions
The Bedford, Concord, Lexington, and Lincoln Boards of Selectmen
The Hanscom Area Towns Committee
Minute Man National Historic Park

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800), and MGL c. 9, ss. 26-27C (950 CMR 70). Please contact Edward L. Bell (Senior Archaeologist) or Brandee Loughlin (Preservation Planner) at the MHC if you have any questions.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: Donald C. Morris, USAF
Bedford, Concord, Lexington, and Lincoln Historical Commissions
Bedford, Concord, Lexington, and Lincoln Boards of Selectmen
The Hanscom Area Towns Committee
Minuteman National Historic Park

TOWN OF LINCOLN

MIDDLESEX COUNTY MASSACHUSETTS

TOWN OFFICES
16 Lincoln Road,
Lincoln, MA 01773
Phone: 781-259-2613
Fax: 781-259-4300
carrolle@lincolntown.org

Lincoln Historical Commission ***Historic District Commission***

July 11, 2012

AECOM
701 Edgewater Drive
Wakefield, MA 01880

Dear Sirs:

The Lincoln Historical Commission thanks you for your letter of June 11, 2012, informing the Commission of the proposed facilities for MIT's Lincoln Laboratory at Hanscom Air Force Base. Although the Commission does not have any direct jurisdiction over the project, it asks that awareness be given in the construction process to areas of archaeological sensitivity and historic stone walls. These have been identified in Figure 2-46 included in the packet of information.

Sincerely,

Lucretia H. Giese

Lucretia H. Giese, Chair
for the Lincoln Historical Commission

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth

Massachusetts Historical Commission

July 5, 2013

Donald C. Morris
Environmental Director
Department of the Air Force
66 MSG/CE 120 Grenier Street
Hanscom AFB, MA 01731-1910

RE: Massachusetts Institute of Technology Lincoln Laboratory New Facilities, Southwest Lab Project, Hanscom Air Force Base, Lexington, MA. PAL #2765. MHC #RC.52118.

Dear Mr. Morris:

Staff of the Massachusetts Historical Commission (MHC), office of the State Historic Preservation Officer, have reviewed the technical archaeological report prepared by the PAL, *Intensive (Locational) Archaeological Survey for MIT Lincoln Laboratory's Southwest Lab Project on Behalf of Hanscom Air Force Base, Lexington, Massachusetts.*

As you will recall, the MHC commented on March 14, 2012, regarding several project alternatives. The archaeological survey was undertaken for an archaeologically sensitive portion of a preferred alternative called the West Lab and Southwest Lab.

The results of the archaeological survey in the proposed Southwest Lab area identified one ancient Native American archaeological site, called the Katahdin Hill Site. Three pieces of stone tool maintenance or manufacturing debris were found. It is the MHC's opinion that the Katahdin Hill Site does not meet the Criteria of Eligibility for listing in the National Register of Historic Places because the site is not likely to provide any additional important archaeological information. Please take these comments about the results of the archaeological site identification effort into account in preparing the US Air Force's determinations and findings for the project.

Some of the project alternatives presented would result in new construction within the proposed boundaries of the AFRL Katahdin Hill/Phillips Lab area. The US Air Force and the MHC have previously agreed that the Air Force Research Lab Katahdin Hill/Phillips Lab area meets the Criteria of Eligibility for listing in the National Register of Historic Places (36 CFR Part 60). The MHC looks forward to continued consultation as project plans progress, including review of the proposed design of the new construction if it is to be placed within the boundaries of the AFRL Katahdin Hill/Philips Lab area.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800). Please contact Edward L. Bell (Deputy State Historic Preservation Officer and Senior Archaeologist) or Brandee Loughlin (Preservation Planner) at the MHC, if you have any questions or need more information.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: see attached

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.state.ma.us/sec/mhc

xc:
James Petras, AECOM
Bedford, Concord, Lexington, and Lincoln Historical Commissions
Bedford, Concord, Lexington, and Lincoln Boards of Selectmen
The Hanscom Area Towns Committee
Minuteman National Historic Park
Deborah C. Cox, PAL Attn. Duncan Ritchie

APPENDIX B: CONFORMITY ANALYSIS (AIR QUALITY)

B.1 Introduction

Under Section 176(c) of the Clean Air Act, a project is in "conformity" if it corresponds to the State Implementation Plan's (SIP) purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards (NAAQS), and achieving the expeditious attainment of the standards. The EPA published final rules on general conformity (40 CFR Parts 51 and 93 in the Federal Register on November 30, 1993 and revised on March 24, 2010) that apply to federal actions in areas in non-attainment for any of the criteria pollutants. They specify *de minimis* emission levels by pollutant to determine the applicability of conformity requirements for a project. A formal conformity determination is required when the annual net total of direct and indirect emissions from a federal action occurring in a non-attainment area equals or exceeds the applicable *de minimis* levels. If a federal action meets the *de minimis* requirements, it is exempt from further conformity analysis pursuant to 40 CFR Part 93.153 and is considered to have minimal air quality impacts.

The proposed project is located in Massachusetts, which is currently designated as (moderate) non-attainment for ozone and is in "maintenance" of its carbon monoxide (CO) attainment. Therefore, the following General Conformity Rule (GCR) analysis has been completed for ozone (as required) for the Proposed Action. Information regarding CO was also included in this analysis, as Massachusetts is in maintenance for CO. In addition, a conformity analysis is only required for the Preferred Alternative (C/J Lot); however, emissions information for the other three alternatives is provided for comparison purposes.

This GCR analysis was conducted in accordance with the EPA final rules on general conformity. Under the GCR, reasonably foreseeable emissions (indirect and direct) associated with operational and construction activities must be quantified and compared to the annual *de minimis* threshold applicable to the pollutants for which the area is in non-attainment.

Ozone results from photochemical reactions in the atmosphere involving precursor pollutants such as volatile organic compounds (VOCs) and nitrogen oxides (NO_x). The *de minimus* thresholds applicable to air quality in Massachusetts are:

VOCs - 50 tons per year
NO_x - 100 tons per year
CO - 100 tons per year

B.2 Construction Activity and Emissions

An estimate to identify equipment, material and manpower requirements for the construction associated with the replacement laboratory facilities at Hanscom Air Force Base near Bedford,

Massachusetts has been conducted. Estimates as to construction crew and equipment requirements and productivity are based on data presented in:

- "2003 RSMeans Facilities Construction Cost Data", R.S. Means Co., Inc., 2002
- "2011 RSMeans Facilities Construction Cost Data", R.S. Means Co., Inc., 2010

The assumptions and calculations are based on the information described in this EA (MIT LL Facilities Replacement on HAFB Phase 1). The proposed work includes the construction of laboratory and support facilities, the full extent of which varies across four different alternatives. Eventually, the proposed construction would create 500,000 square feet (SF) of new laboratory space. However, because this cannot be constructed in a single action, one building of 145,000 to 175,000 SF (depending on the site selected) would be constructed in Phase 1, and another building of an approximate 325,000 SF would be constructed in Phase 2, at a site to be selected in the future. For purposes of this planning-level estimate, the construction effort for a single building with 175,000 SF of occupiable space was estimated. The site preparatory work for each Alternative would then be considered separately, in order to arrive at the final estimate for each of the four proposed Alternatives.

The buildings are described generically as being steel-framed, on concrete foundations and slabs. Based on building footprints versus total building floor area, it is assumed that the representative building would be a 3-story building with a footprint of 100,000 SF (400-ft by 250-ft exterior dimensions), and include elevators and full mechanical systems (a conservative assumption, as cooling is proposed to be provided by the campus chilled water plant). It is assumed that the building would have large architectural bays (25-ft on center, 20-ft floor height) to accommodate clean rooms and other large equipment to be installed by the laboratories, would have unit masonry wall envelope and mechanical core, Q-decking and concrete floor and roof slabs, and a grade-beam foundation to support the concentrated high loadings due to the large-bay construction.

During construction activities, emissions would result from the operation of construction equipment, trucks, and workers' commuting vehicles. To estimate construction-related emissions, the type of equipment that would be used, the likely duration of each activity, and manpower requirements were projected. All construction activities were conservatively assumed to take place within one year. Emissions from construction equipment were calculated for each alternative based on estimated hours of equipment use and emission factors for each type of equipment from the EPA's NONROAD emission factor model (Tables B-1a through B-1d). Estimated emissions from trucks and commuting vehicles for each alternative are included in Tables B-2a through B-2d.

If the proposed replacement facility is constructed at Alternative 4, it is assumed that a surface parking lot would be constructed around the new building. The VOC emissions resulting from construction (asphalt paving) of a surface parking lot were calculated and are included for

Alternative 4 in Table B-3. Paving was conservatively assumed to take place within the same year as building construction.

B.3 Operational Activity and Emissions

After the completion of construction activities, the proposed replacement facility would need to be heated and backup power would need to be provided with the operation of stationary sources such as boilers and emergency generators. Each of these stationary source activities could represent a new source of (or an increase in) air emissions. If the new building is to be heated by the HAFB Central Heat Plant, the impact on air quality would not be meaningfully distinguished from the current overall emissions of the CHP. If the heating is decentralized, the proposed building is expected to require stand-alone boiler(s). The building would also have a standby diesel-powered generator. The anticipated annual emissions from potential new boilers and emergency generators were predicted using the USEPA AP-42 emission factor handbook and the likely heating hours per year for the boilers and the maximum operational hours for emergency generators. The estimated annual emissions from the proposed boiler(s) are presented in Table B-4 and from the generator are presented in Table B-5. Potential emissions from the boilers would be based on 8,760 hours per year of operation for permitting applicability, as regulatory "potential to emit" calculations are inherently conservative compared to more likely operating scenarios.

B.4 General Conformity Applicability Determination

The total estimated emissions from construction and operation of the project are summarized in Tables B-6 and B-7, respectively. The total construction emissions are anticipated to range, depending on the site selected, from approximately 0.6 to 0.9 tons/year for VOC, 3.3 to 4.4 tons/year for NO_x, and 7.4 to 9.7 tons/year for CO. The worst-case total emissions of the stationary sources (i.e. boilers and generators) are anticipated to range from approximately 0.30 to 0.47 tons/year for VOC, 10.69 to 16.72 tons/year for NO_x, and 2.58 to 4.08 tons/year for CO. On an annual basis, both construction and operational emissions predicted would not exceed the *de minimus* thresholds of 50 tons per year for VOC, 100 tons per year for NO_x, or 100 tons per year for CO. Therefore, a formal conformity determination is not required for the Proposed Action, regardless of the alternative selected, and air quality impacts would not be significant.

Table B-1a Estimated Annual Emissions from Construction Equipment – Preferred Alternative (C/J Lot)

Equipment Type	Total Hours of Operation	Horsepower[1] (hp)	Load Factor[1] (%)	Emission Factor (grams/hp-hour)[1]			Emission Rate (tons)		
				VOC	NO_x	CO	VOC	NO_x	CO
Backhoe Loader, 48 hp	376	48	21	1.47	6.80	6.42	0.006	0.028	0.027
Centrifugal. water pump, 6"	40	53	43	0.75	6.18	3.03	0.001	0.006	0.003
Compressor, 250 cfm	2720	90	43	0.32	4.01	2.63	0.038	0.465	0.305
Concrete pump, small	1152	53	43	0.75	6.18	3.03	0.022	0.178	0.087
Crane, 90-ton	272	231	43	0.35	5.14	1.30	0.011	0.153	0.039
Crane, 150-ton	272	231	43	0.35	5.14	1.30	0.011	0.153	0.039
Crane, hydraulic, 33 ton	16	62	43	0.56	5.41	2.43	0.000	0.003	0.001
Drill rig & augers	24	176	43	0.57	6.68	2.36	0.001	0.013	0.005
Dozer, 300 HP	40	300	59	0.33	4.72	1.93	0.003	0.037	0.015
Front end loader, 1.5 cy, crl	24	243	59	0.37	5.05	2.09	0.001	0.019	0.008
Front end loader, 2.5cy	376	243	59	0.37	5.05	2.09	0.022	0.299	0.124
Gas engine vibrator	720	2	55	57.01	1.42	291.97	0.041	0.001	0.210
Gas welding machine	2584	66	68	2.02	7.26	38.49	0.258	0.927	4.916
Grader, 30,000 lb	80	204	59	0.32	4.26	1.45	0.003	0.045	0.015
Hydraulic excavator, 3.5 cy	72	171	59	0.32	4.25	1.64	0.003	0.034	0.013
Hydraulic hammer, 1200 lb	376	62	43	0.56	5.41	2.43	0.006	0.060	0.027
Pavement removal bucket	376	171	59	0.32	4.25	1.64	0.013	0.178	0.069
Roller, vibratory	24	92	59	0.42	4.77	2.49	0.001	0.007	0.004
Total Construction Equipment Emissions							**0.44**	**2.61**	**5.91**

Notes
1. NONROAD emission factors worksheet, USEPA email 12/31/2008
2. All construction is conservatively assumed to take place in one year.

Table B-1b Estimated Annual Emissions from Construction Equipment – Alternative 2 (J Building)

Equipment Type	Total Hours of Operation	Horsepower[1] (hp)	Load Factor[1] (%)	Emission Factor (grams/hp-hour)[1]			Emission Rate (tons)		
				VOC	NOx	CO	VOC	NOx	CO
Building J Demolition, Parking Lot Removal, and Construction of Replacement Facility									
Backhoe loader, 48hp	120	48	21	1.47	6.80	6.42	0.002	0.009	0.009
Centrif. water pump, 6"	40	53	43	0.75	6.18	3.03	0.001	0.006	0.003
Compressor, 250 cfm	4960	90	43	0.32	4.01	2.63	0.069	0.848	0.556
Concrete pump, small	1152	53	43	0.75	6.18	3.03	0.022	0.178	0.087
Crane, 90-ton	272	231	43	0.35	5.14	1.30	0.011	0.153	0.039
Crane, 150-ton	272	231	43	0.35	5.14	1.30	0.011	0.153	0.039
Crane, hydraulic, 33 ton	16	62	43	0.56	5.41	2.43	0.000	0.003	0.001
Drill rig & augers	24	176	43	0.57	6.68	2.36	0.001	0.013	0.005
Dozer, 300 HP	24	300	59	0.33	4.72	1.93	0.002	0.022	0.009
Front end loader, 1.5 cy, crl	24	243	59	0.37	5.05	2.09	0.001	0.019	0.008
Front end loader, 2.5cy	120	243	59	0.37	5.05	2.09	0.007	0.095	0.040
Front end loader, TM, 2.5cy	240	243	59	0.37	5.05	2.09	0.014	0.191	0.079
Gas engine vibrator	720	2	55	57.01	1.42	291.97	0.041	0.001	0.210
Gas welding machine	2584	66	68	2.02	7.26	38.49	0.258	0.927	4.916
Grader, 30,000 lb	80	204	59	0.32	4.26	1.45	0.003	0.045	0.015
Hydraulic excavator, 3.5 cy	24	171	59	0.32	4.25	1.64	0.001	0.011	0.004
Hydraulic hammer, 1200 lb	120	62	43	0.56	5.41	2.43	0.002	0.019	0.009
Pavement Removal Bucket	120	171	59	0.32	4.25	1.64	0.004	0.057	0.022
Pavement breaker, 60lb	4000	70	59	0.47	5.00	2.64	0.086	0.904	0.478
Roller, vibratory	24	92	59	0.42	4.77	2.49	0.001	0.007	0.004
Total Construction Equipment Emissions							**0.53**	**3.66**	**6.53**

Notes
1. NONROAD emission factors worksheet, USEPA email 12/31/2008
2. All construction is conservatively assumed to take place in one year.

Table B-1c Estimated Annual Emissions from Construction Equipment– Alternative 3 (Hillside at Gate 3A)

Equipment Type	Total Hours of Operation	Horsepower[1] (hp)	Load Factor[1] (%)	Emission Factor (grams/hp-hour)[1]			Emission Rate (tons)		
				VOC	NOx	CO	VOC	NOx	CO
Site Clearing (Tree/Stump Removal) and Construction of Replacement Facility									
Centrif. water pump, 6"	56	53	43	0.75	6.18	3.03	0.001	0.009	0.004
Compressor, 250 cfm	3904	90	43	0.32	4.01	2.63	0.054	0.668	0.437
Concrete pump, small	1656	53	43	0.75	6.18	3.03	0.031	0.255	0.125
Crane, 90-ton	384	231	43	0.35	5.14	1.30	0.015	0.216	0.054
Crane, 150-ton	384	231	43	0.35	5.14	1.30	0.015	0.216	0.054
Crane, hydraulic, 33 ton	24	62	43	0.56	5.41	2.43	0.000	0.004	0.002
Drill rig & augers	32	176	43	0.57	6.68	2.36	0.002	0.018	0.006
Dozer, 300 HP	96	300	59	0.33	4.72	1.93	0.006	0.088	0.036
Front end loader, 1.5 cy, crl	32	243	59	0.37	5.05	2.09	0.002	0.025	0.011
Gas engine vibrator	1032	2	55	57.01	1.42	291.97	0.059	0.001	0.301
Gas welding machine	3712	66	68	2.02	7.26	38.49	0.370	1.332	7.062
Grader, 30,000 lb	104	204	59	0.32	4.26	1.45	0.004	0.059	0.020
Roller, vibratory	32	92	59	0.42	4.77	2.49	0.001	0.009	0.005
Grader, 30,000 lb	72	204	59	0.32	4.26	1.45	0.003	0.041	0.014
Hydraulic excavator, 3.5 cy	408	62	43	0.56	5.41	2.43	0.007	0.065	0.029
Total Emissions							**0.57**	**3.01**	**8.16**

Notes
1. NONROAD emission factors worksheet, USEPA email 12/31/2008
2. All construction is conservatively assumed to take place in one year.

Table B-1d Estimated Annual Emissions from Construction Equipment– Alternative 4 (AFRL Open Field)

Equipment Type	Total Hours of Operation	Horsepower[1] (hp)	Load Factor[1] (%)	Emission Factor (grams/hp-hour)[1]			Emission Rate (tons)		
				VOC	NOx	CO	VOC	NOx	CO
Construction of Replacement Facility and Creation/Paving of 200 parking spaces									
Asphalt paver, 130 HP	32	130	59	0.37	4.54	1.60	0.001	0.012	0.004
Centrif. water pump, 6"	56	53	43	0.75	6.18	3.03	0.001	0.009	0.004
Compressor, 250 cfm	3904	90	43	0.32	4.01	2.63	0.054	0.668	0.437
Concrete pump, small	1656	53	43	0.75	6.18	3.03	0.031	0.255	0.125
Crane, 90-ton	384	231	43	0.35	5.14	1.30	0.015	0.216	0.054
Crane, 150-ton	384	231	43	0.35	5.14	1.30	0.015	0.216	0.054
Crane, hydraulic, 33 ton	24	62	43	0.56	5.41	2.43	0.000	0.004	0.002
Drill rig & augers	32	176	43	0.57	6.68	2.36	0.002	0.018	0.006
Dozer, 300 HP	48	300	59	0.33	4.72	1.93	0.003	0.044	0.018
Front end loader, 1.5 cy, crl	48	243	59	0.37	5.05	2.09	0.003	0.038	0.016
Gas engine vibrator	1032	2	55	57.01	1.42	291.97	0.059	0.001	0.301
Gas welding machine	3712	66	68	2.02	7.26	38.49	0.370	1.332	7.062
Grader, 30,000 lb	136	204	59	0.32	4.26	1.45	0.006	0.077	0.026
Hydraulic excavator, 3.5 cy	112	62	43	0.56	5.41	2.43	0.002	0.018	0.008
Pneumatic wheel roller	32	92	59	0.42	4.77	2.49	0.001	0.009	0.005
Roller, vibratory	48	92	59	0.42	4.77	2.49	0.001	0.014	0.007
Rollers, steel wheel	32	92	59	0.42	4.77	2.49	0.001	0.009	0.005
Tandem roller, 10 ton	16	92	59	0.42	4.77	2.49	0.000	0.005	0.002
Total Emissions							**0.56**	**2.94**	**8.14**

Notes

1NONROAD emission factors worksheet, USEPA email 12/31/2008

2. All construction is conservatively assumed to take place in one year.

Table B-2a Estimated Annual Emissions from Motor Vehicles during Construction – Preferred Alternative (C/J Lot)

<table>
<tr><th colspan="2" rowspan="2">Activity</th><th rowspan="2">Hours Of Operation</th><th colspan="3">Emission Factor (lbs/hr)</th><th colspan="3">Emissions (tons)</th></tr>
<tr><th>VOC</th><th>NO_x</th><th>CO</th><th>VOC</th><th>NO_x</th><th>CO</th></tr>
<tr><td colspan="9">Truck Emissions</td></tr>
<tr><td colspan="2">Replacement Facility Construction</td><td rowspan="4">7,080</td><td rowspan="4">0.0204</td><td rowspan="4">0.177</td><td rowspan="4">0.057</td><td rowspan="4">0.072</td><td rowspan="4">0.626</td><td rowspan="4">0.201</td></tr>
<tr><td>Total trucks =</td><td>15</td></tr>
<tr><td>Total working days =</td><td>236</td></tr>
<tr><td>Running hrs per veh per day =</td><td>2</td></tr>
<tr><td colspan="9">Commuter Vehicle Emissions</td></tr>
<tr><td colspan="2">Replacement Facility Construction</td><td rowspan="4">6,975</td><td rowspan="4">0.0328</td><td rowspan="4">0.0276</td><td rowspan="4">0.3781</td><td rowspan="4">0.114</td><td rowspan="4">0.096</td><td rowspan="4">1.319</td></tr>
<tr><td>Total vehicles =</td><td>75</td></tr>
<tr><td>Total working days =</td><td>279</td></tr>
<tr><td>Minutes on site round trip =</td><td>20</td></tr>
<tr><td colspan="6">Total Construction Vehicle Emissions</td><td>0.19</td><td>0.72</td><td>1.52</td></tr>
</table>

Table B-2b Estimated Annual Emissions from Motor Vehicles during Construction – Alternative 2 (J Building)

Activity		Hours Of Operation	Emission Factor (lbs/hr)			Emissions (tons)		
			VOC	NO_x	CO	VOC	NO_x	CO
Truck Emissions								
Building J Demolition, Parking Lot Removal, and Construction of Replacement Facility		7,320	0.0204	0.177	0.057	0.075	0.647	0.208
Total trucks =	15							
Total working days =	244							
Running hrs per veh per day =	2							
Commuter Vehicle Emissions								
Building J Demolition, Parking Lot Removal, and Construction of Replacement Facility		7,375	0.0328	0.0276	0.3781	0.121	0.102	1.394
Total vehicles =	75							
Total working days =	295							
Minutes on site round trip =	20							
Total Construction Vehicle Emissions						**0.20**	**0.75**	**1.60**

Table B-2c Estimated Annual Emissions from Motor Vehicles during Construction – Alternative 3 (Hillside at Gate 3A)

Activity		Hours Of Operation	Emission Factor (lbs/hr)			Emissions (tons)		
			VOC	NO_x	CO	VOC	NO_x	CO
Truck Emissions								
Site Clearing (Tree/Stump Removal) and Construction of Replacement Facility		6,600	0.0204	0.177	0.057	0.067	0.584	0.188
Total trucks =	15							
Total working days =	220							
Running hrs per veh per day =	2							
Commuter Vehicle Emissions								
Site Clearing (Tree/Stump Removal) and Construction of Replacement Facility		6,925	0.0328	0.0276	0.3781	0.113	0.096	1.309
Total vehicles =	75							
Total working days =	277							
Minutes on site round trip =	20							
Total Construction Vehicle Emissions						**0.18**	**0.68**	**1.50**

Table B-2d Estimated Annual Emissions from Motor Vehicles during Construction – Alternative 4 (AFRL Open Field)

Activity		Hours Of Operation	Emission Factor (lbs/hr)			Emissions (tons)		
			VOC	NO_x	CO	VOC	NO_x	CO
Truck Emissions								
Construction of Replacement Facility and Creation/Paving of 200 parking spaces		6,660	0.0204	0.177	0.057	0.068	0.589	0.189
Total trucks =	15							
Total working days =	222							
Running hrs per veh per day =	2							
Commuter Vehicle Emissions								
Construction of Replacement Facility and Creation/Paving of 200 parking spaces		6,925	0.0328	0.0276	0.3781	0.113	0.096	1.309
Total vehicles =	75							
Total working days =	277							
Minutes on site round trip =	20							
Total Construction Vehicle Emissions						**0.18**	**0.68**	**1.50**

Table B-3 Estimated Annual Asphalt Pavement VOC Emissions – Alternative 4

Pavement square yards	Hot Mix Emission Factor (lbs/ton)[1]	Emulsified Emission Factor (lbs/ton)[2]	Hot Mix Application Rate (gal/SY)[3]	Primary Coat Application Rate (gal/SY)[4]	Tack Coat Application Rate (gal/SY)[4]	Hot Mix, Primary & Tack Coat asphalt (tons VOC/SY)	Annual Emissions VOC (tons)
8,000	0.040	17.900	0.060	0.25	0.30	2.05×10^{-5}	**0.164**

Notes
1. Hot Mix Emulsified emission factors were obtained from the SMAQMD *1991 survey* (SMAQMD, 1991).
2. Emulsified Emission factors are used for Primary and Tack Coats.
3. Hot Mix application rate was obtained from the *Hot-Mix Asphalt Paving Handbook* (USACE, 2000).
4. Primary and Tack Coat Application rates were obtained from: *Road and Bridge Specifications* (FHWA, 2002).
The density of asphalt (8.34 lb/gal) used in the calculations was obtained from: US EPA, *Emission Inventory Improvement Program Technical Report Series* (US EPA, 2001).
5. All paving is conservatively assumed to take place in one year.

Table B-4 Estimated Annual Boiler Emissions

	Boiler input (Btu/hr)	Annual Hours[1]	Diesel Boiler Emission Factor (lb/MMBTU)[2]			Diesel Boiler Annual Emissions (TPY)		
			NOx	VOC[3]	CO	NOx	VOC	CO
Minimum								
C/J Lot	15,600,000	4320	0.14	0.004	0.036	4.81	0.13	1.20
J Building	15,600,000	4320	0.14	0.004	0.036	4.81	0.13	1.20
Hillside at Gate 3A	15,600,000	4320	0.14	0.004	0.036	4.81	0.13	1.20
AFRL Open Field	15,600,000	4320	0.14	0.004	0.036	4.81	0.13	1.20
Maximum								
C/J Lot	19,000,000	4320	0.14	0.004	0.036	5.86	0.16	1.47
J Building	19,000,000	4320	0.14	0.004	0.036	5.86	0.16	1.47
Hillside at Gate 3A	19,000,000	4320	0.14	0.004	0.036	5.86	0.16	1.47
AFRL Open Field	19,000,000	4320	0.14	0.004	0.036	5.86	0.16	1.47

Notes
1. Cold weather months operating 16 hours per day continuously for heat and hot water.
   Warm weather months operating 8 hours per day continuously for hot water.
2. USEPA AP-42 emission factors for external combustion fuel oil (diesel fuel).
   140 MMBTU/10^3 gal.
3. VOC emissions use TOC emission factor.

Table B-4a Potential To Emit Annual Boiler Emissions

	Boiler input (Btu/hr)	Annual Hours	Diesel Boiler Emission Factor (lb/MMBTU)[1]			Diesel Boiler Annual Emissions (TPY)		
			NOx	VOC[2]	CO	NOx	VOC	CO
Minimum								
C/J Lot	15,600,000	8760	0.143	0.004	0.036	9.76	0.27	2.44
J Building	15,600,000	8760	0.143	0.004	0.036	9.76	0.27	2.44
Hillside at Gate 3A	15,600,000	8760	0.143	0.004	0.036	9.76	0.27	2.44
AFRL Open Field	15,600,000	8760	0.143	0.004	0.036	9.76	0.27	2.44
Maximum								
C/J Lot	19,000,000	8760	0.143	0.004	0.036	11.89	0.33	2.97
J Building	19,000,000	8760	0.143	0.004	0.036	11.89	0.33	2.97
Hillside at Gate 3A	19,000,000	8760	0.143	0.004	0.036	11.89	0.33	2.97
AFRL Open Field	19,000,000	8760	0.143	0.004	0.036	11.89	0.33	2.97

Notes
1. USEPA AP-42 emission factors for external combustion fuel oil (diesel fuel).
   140 MMBTU/10^3 gal.
2. VOC emissions use TOC emission factor.

Table B-5 Estimated Annual Generator Emissions

	Generator Power (MW/HP)	Annual Hours	Diesel Generator Emission Factor (lb/hp-hr)[1]			Diesel Generator Annual Emissions (TPY)		
			NOx[2]	VOC[3]	CO	NOx	VOC	CO
C/J Lot	1.0 /1341	300	0.024	0.00071	0.0055	4.83	0.14	1.11
J Building	1.0 /1341	300	0.024	0.00071	0.0055	4.83	0.14	1.11
Hillside at Gate 3A	1.0 /1341	300	0.024	0.00071	0.0055	4.83	0.14	1.11
AFRL Open Field	1.0 /1341	300	0.024	0.00071	0.0055	4.83	0.14	1.11

Notes
1. USEPA AP-42 emission factors for large diesel engines.
2. Uncontrolled NOx emission factor.
3. VOC emissions use TOC (as CH_4) emission factor.

Table B-6 Summary of Total Annual Construction Emissions Levels

Emission Source	Pollutant (tons/year)		
	VOC	**NO_x**	**CO**
Construction Emissions (2015 to 2017)			
Alternative 1 (C/J Lot)			
Construction Equipment	0.44	2.61	5.91
Motor Vehicles	0.19	0.72	1.52
Total Alternative 1 Construction Emissions	**0.63**	**3.33**	**7.43**
Alternative 2 (J Building)			
Construction Equipment	0.53	3.66	6.53
Motor Vehicles	0.20	0.75	1.60
Total Alternative 2 Construction Emissions	**0.73**	**4.41**	**8.13**
Alternative 3 (Hillside at Gate 3A)			
Construction Equipment	0.57	3.01	8.16
Motor Vehicles	0.18	0.68	1.50
Total Alternative 3 Construction Emissions	**0.75**	**3.69**	**9.66**
Alternative 4 (AFRL Open Field)			
Construction Equipment	0.56	2.94	8.14
Motor Vehicles	0.18	0.68	1.50
Paving	0.16	-	-
Total Alternative 4 Construction Emissions	**0.90**	**3.62**	**9.64**
De Minimis Level	***50***	***100***	***100***

Table B-7 Summary of Total Annual Operation Emissions Levels

Emission Source	Pollutant (tons/year)		
	VOC	NO_x	CO
Operating Emissions (2017 and on)			
Minimum			
Generators	0.14	4.83	1.11
Boilers	0.13	4.81	1.20
Total	**0.27**	**9.64**	**3.42**
Maximum			
Generators	0.14	4.83	1.11
Boilers	0.16	5.86	1.47
Total	**0.30**	**10.69**	**2.58**
De Minimis Level	***50***	***100***	***100***

APPENDIX C: FACILITY CONDITION ASSESSMENT

Improving the Way You Manage Facilities

Facility Condition Assessment

for

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts

FEA Project R09.2008.000038

October 27, 2008

Facility Engineering Associates, P.C.
1601 Trapelo Road, Suite 182
Waltham, Massachusetts 02451
(781) 890-2254
www.feapc.com

FACILITY ENGINEERING ASSOCIATES
1601 TRAPELO ROAD, SUITE 182
WALTHAM, MASSACHUSETTS 02451

(781) 890-2254
www.feapc.com

October 27, 2008

E.B. Litchfield
Project Manager
Physical Plant Engineering
MIT Lincoln Laboratory
244 Wood Street
Lexington, Massachusetts 02420-9108

SUBJECT: **Final Report of Facility Condition Assessments (26 Buildings and Site Systems)**
MIT Lincoln Laboratory
Lexington, MA
FEA Project No. R09.2008.000038

Dear Mr. Litchfield:

Facility Engineering Associates, P.C. (FEA) is pleased to submit to MIT Lincoln Laboratory (MIT LL) our report of the Facility Condition Assessment of 26 buildings and site systems located on the MIT LL campus, located in Lexington, Massachusetts.

This work was performed in accordance with FEA Proposal No. P09.2008.000038 (Phase 001, 002, and 003) dated April 18, 2008, (with subsequent Phase 004, dated June 9, 2008). Phase 004 was requested for FEA to perform Preliminary Energy Audits of the 26 buildings included in the facility condition assessment study.

This report contains several sections. The report opens with an executive summary, which includes discussions of our general project approach, roll-up of findings and general conditions, comparison findings, the analysis of the condition assessment results, and an overview of our general findings of the buildings. The main body that follows consists of further details of our assessment methodology and assumptions. The tabbed sections are the individual assessment reports for the buildings and site.

We appreciate you selecting FEA for this work and look forward to continuing to assist you with your facility management needs.

Very truly yours,
FACILITY ENGINEERING ASSOCIATES, P.C.

Rebecca A. Gutierrez
Rebecca A. Gutierrez, E.I.T., R.S.
Project Manager

James P. Whittaker
James P. Whittaker, P.E. CFM, EFP, FRICS
Associate-in-Charge

TABLE OF CONTENTS

EXECUTIVE SUMMARY

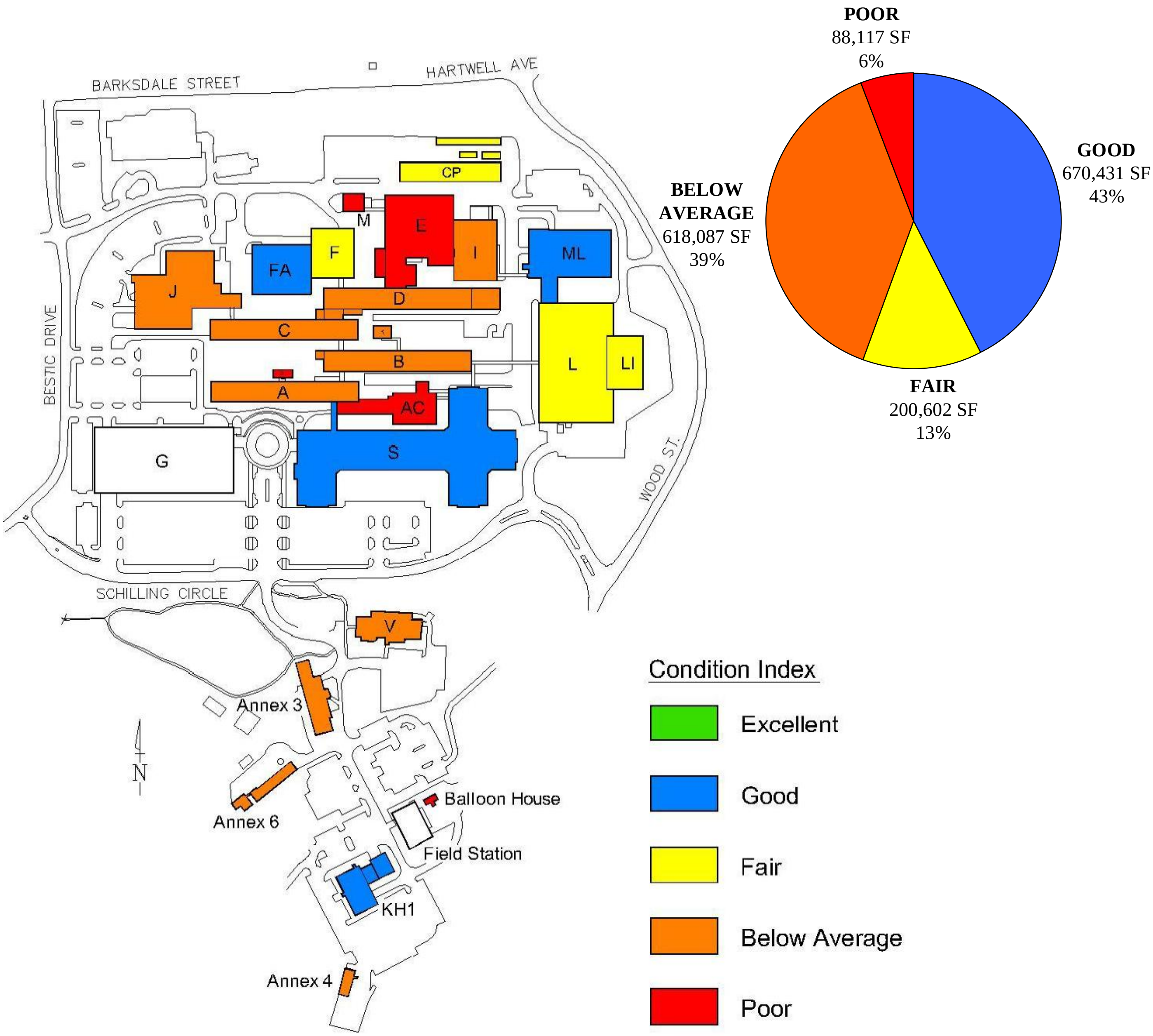
Facility Engineering Associates (FEA) performed a Facilities Condition Assessment (FCA) of 26 buildings and site systems located on the MIT Lincoln Laboratory (MIT LL) campus in Lexington, MA. The total building area of the 26 buildings was 1,884,470 square feet, as provided by MIT LL. FEA compiled a multi-disciplined team of engineers and facilities professionals to conduct assessments that were organized to review the following major components: Site, Structural, Exteriors, Roofs, Mechanical, Electrical and Plumbing (MEP), Fire and Life Safety, Interiors, and Elevators. A cursory review of ADA (accessibility) issues was also included.

In addition to the assessment of individual buildings, relative comparisons of the building conditions included in the assessment are provided to allow MIT LL to compare results between facilities and provide a decision framework for prioritizing repair decisions. A summary of relevant assessment values is presented in the following table.

MIT Lincoln Laboratory	Data
Number of Buildings	26
Total Building Gross Area	1,884,470 square feet
Current Replacement Value (CRV)[1]	$498.0M
Deferred Maintenance (Years 1 through 5)	$88.8M (buildings) $90.6M (campus)[4]
Total 20-year Expenditures	$177.1M (buildings) $183.1M (campus) [4]
Average Annual Capital Expenditures (over 20 years)	$8.9M (buildings) $9.2M (campus) [4]
Average Facility Condition Index[2] FCI	 0.18
Building with Highest FCI	Building P
Building with Highest DM[3]	Building E
Building with Greatest Capital Expenditures (over 20 years)	Building S

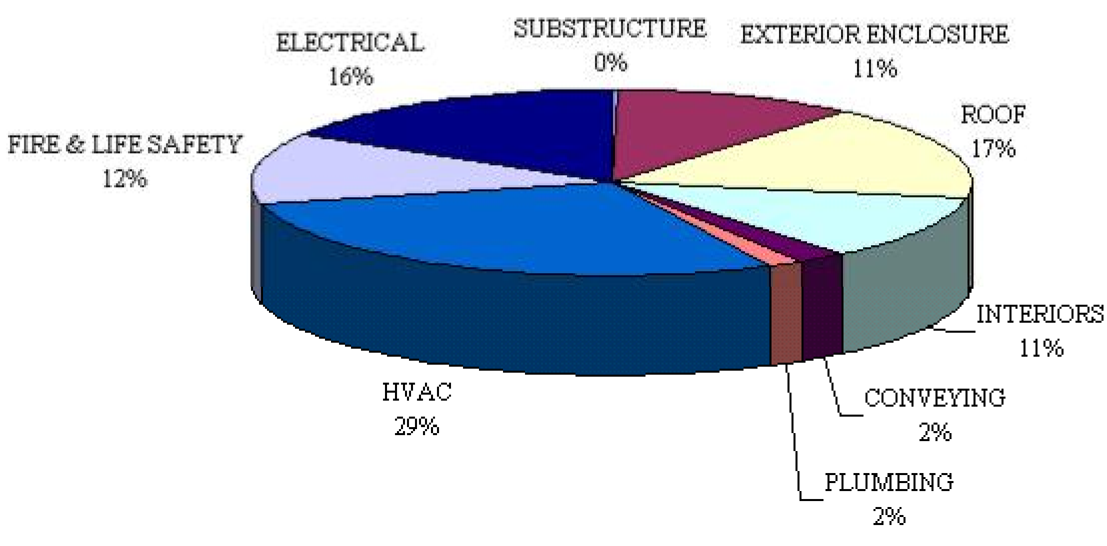
Notes:
1. CRV = Current is considered the approximate value, in current dollars, to replace a building. The CRV is based on the per square foot replacement value provided by MIT LL.
2. FCI = Deferred Maintenance divided by CRV
3. DM = Deferred Maintenance. Repairs or replacements that should have been completed already.
4. Campus values include both buildings and site systems.
5. No inflation is included in the above values; all costs are Net Present Values (NPV).

The following graphic provides a relative comparison of the facility condition index (FCI) values for each building (the lower the FCI, the better the condition of the building). The pie chart indicates the overall fraction of building square footage that falls under each condition. It should be noted that the Building G (Parking Garage) and the Lexington Field Station are not included in the overall summary of building condition due to being unoccupied buildings. Therefore, the square footage of the buildings has been excluded from the graphic. A larger view of this graphic can be found in Appendix A.


POOR
88,117 SF
6%
GOOD
670,431 SF
43%
BELOW AVERAGE
618,087 SF
39%
FAIR
200,602 SF
13%
BARKSDALE STREET
HARTWELL AVE
BESTIC DRIVE
WOOD ST.
SCHILLING CIRCLE
CP
M
E
F
I
FA
ML
J
D
C
B
L
LI
A
AC
G
S
V
Annex 3
N
Annex 6
Balloon House
Field Station
KH1
Annex 4
Condition Index
Excellent
Good
Fair
Below Average
Poor

Based on the results of the facility condition assessment, overall the Old Town buildings ranged from fair to poor condition, the Katahdin Hill buildings were in overall below average to poor condition, while South Lab was generally in good condition. The general durability of construction materials, combined with programmatic-driven renovations and improvements has maintained the buildings in good condition. That said, many of the building systems will be reaching the end of, or have already surpassed their useful functional life and will require replacement within the study period. Previously, funding was not available for keeping up with the growing deferred maintenance (DM) of the buildings; based on FEA's condition assessment, this trend will continue unless strategic measures are implemented. Strategic planning will need to incorporate the necessary funding for maintaining the current buildings, space utilization throughout the campus, and the priority or critically of each building and how they compare to each other. The measures will have to take into account the various building conditions and ages throughout the campus.

Based on our condition assessment, we identified an average annual anticipated capital expenditure requirement of about **$8.9M for the 26 buildings,** and **$9.2M for the campus (buildings and site systems)** over a period of 20 years to meet the needs of reducing the deferred maintenance (DM) backlog and keeping pace with capital renewal requirements. For our assessment and analysis, we have defined DM as the total expenditures recommended during the first five years of the study. The intention of this definition is to capture building system replacements or repairs necessary to bring the buildings back to the desired maintenance level set by MIT LL. Below is a chart showing the fractions of the total DM identified by discipline for the 26 buildings. HVAC, Electrical, and Fire and Life Safety comprise the majority of the expenditures for Years 1 through 5 mainly based on the age of the buildings and the code issues identified.



To nearly eliminate all the DM by 2013 (Year 5 of study period), the average annual expenditures recommended is **$17.8M for the buildings**, and **$18.1M for the campus**.

Annual budgets over the 20-year period less than **$8.9M** (for the buildings) would result in increasing backlogs of deferred maintenance over time. Figure ES-1 shows the potential impact of budget shortfalls on the deferred maintenance backlog.

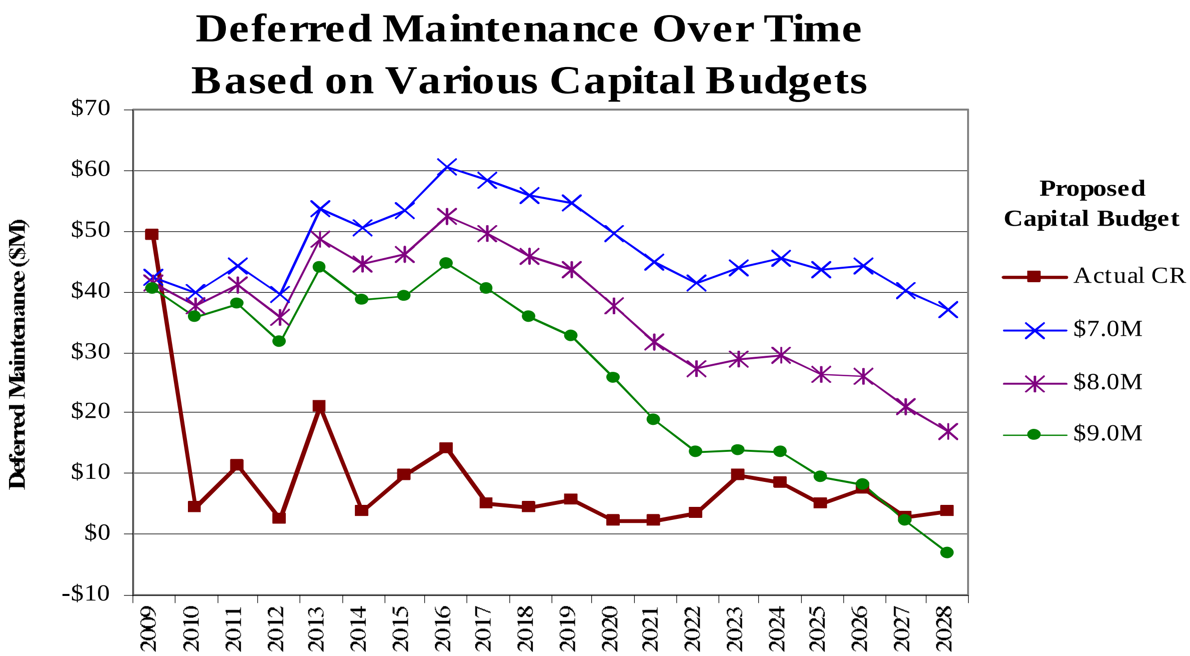


Figure ES-1: Deferred Maintenance over Time Based on Various Capital Budgets

Meeting the anticipated capital needs of the future by budgeting about **$8.9M** per year (for the buildings) would maintain the FCI generally at 0.18 as shown in Figure ES-2. Proposed budgets less than $8.9M per year would result in a gradual increase in FCI over time as shown. Likewise, annual budgets greater than approximately $8.9M would result in a decrease in FCI over time, assuming continuous and appropriate maintenance practices.

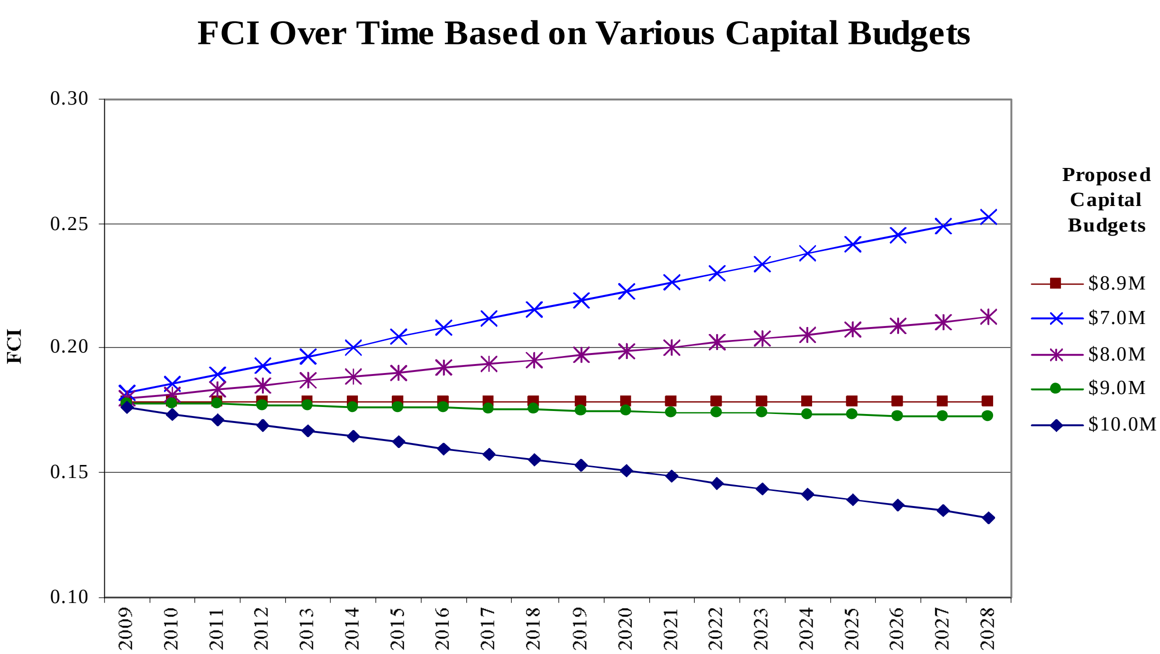
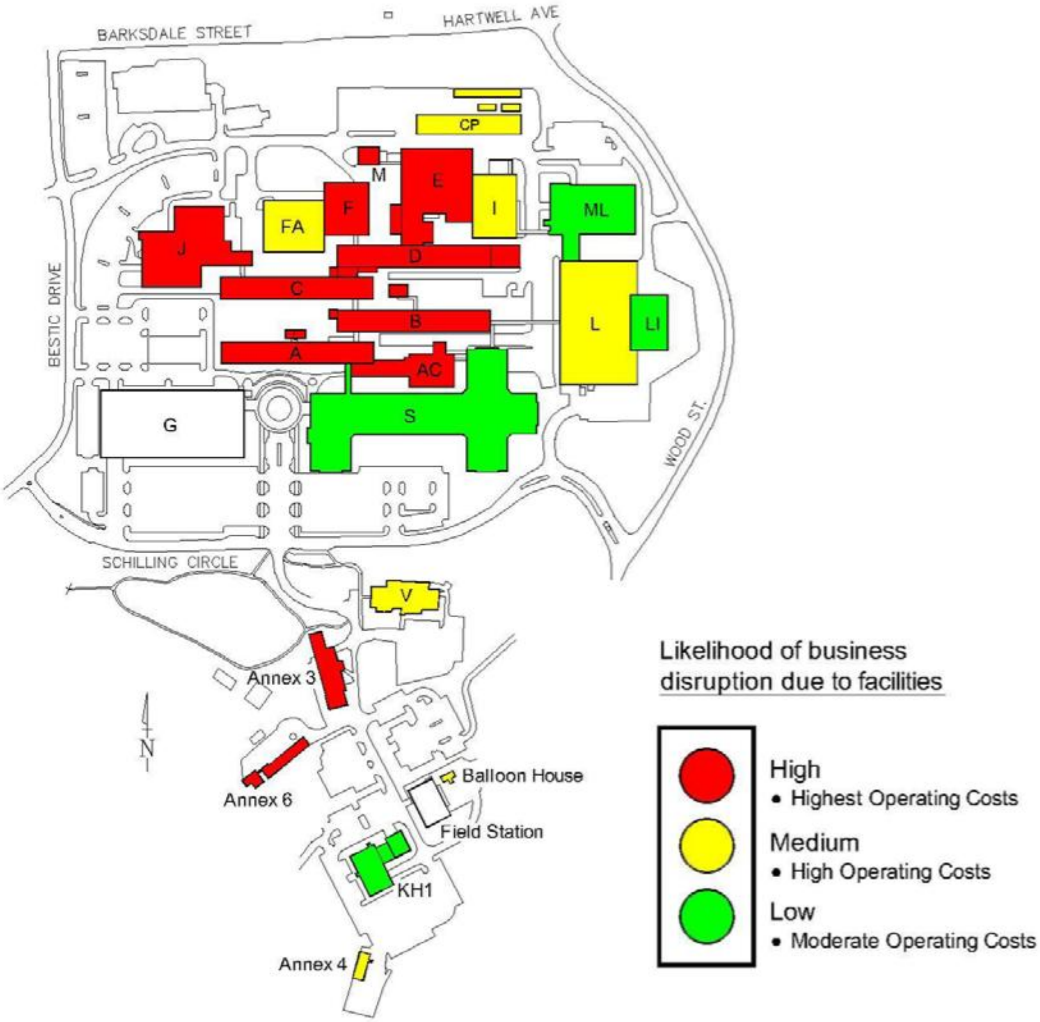


Figure ES-2: FCI Values over Time Based on Various Capital Budgets

To supplement our facility condition assessment, we also performed a risk assessment of the buildings on the MIT LL campus. The building risk level considers the potential impact to health and safety of building occupants and operation of critical programs due to failure of the system, as well as increased maintenance and repair costs for aging systems. Building risk was determined by evaluating building systems with respect to age, estimated useful life (design life), industry standard system degradation curves, condition, maintenance history, probability of failure, and other factors. The following graphic provides a relative comparison of the risk level each building. A larger view of this graphic can be found in Appendix A.



SUMMARY OF FINDINGS

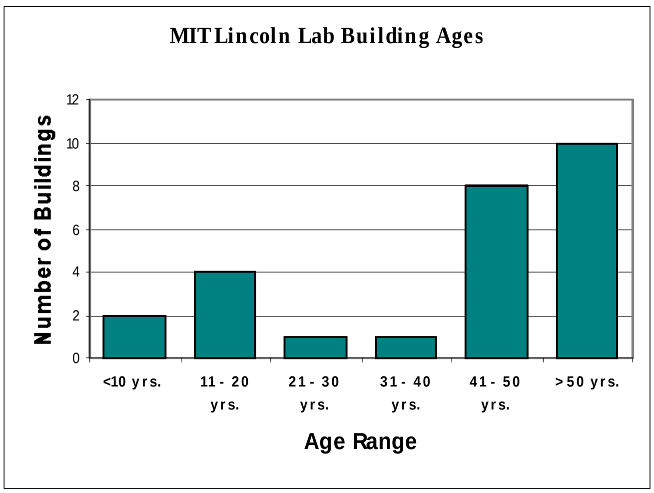
OVERVIEW

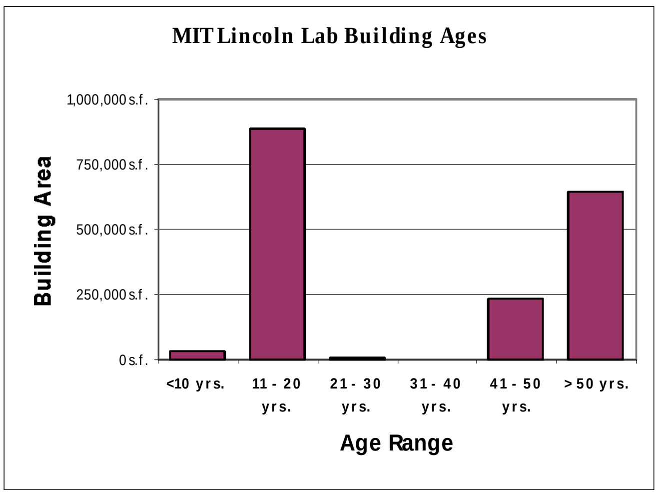
Created in 1951, as a federally funded research and development center (FFRDC) of the Massachusetts Institute of Technology (MIT), Lincoln Laboratory (LL) was focused on improving the nation's air defense system through advanced electronics. Lincoln Laboratory occupies 75 acres (20 acres of which are MIT property) on the eastern perimeter of Hanscom Air Force Base, which is at the nexus of the towns of Lexington, Bedford, Lincoln, and Concord in Massachusetts. The MIT property and most of the Laboratory's facilities are within the Lexington town boundaries.

The majority of MIT LL's facilities are on federal property. The original set of buildings that the Laboratory moved into in the early 1950s is still in use. In the early 1990s, the Laboratory, which had expanded into nearby rental properties, undertook a construction project to consolidate its facilities. This resulted in the approximate 500,000 square-foot South Laboratory (Building S) and an adjacent parking garage.

LL also utilizes 20 acres of MIT property contiguous with the Hanscom Air Force Base. Over the years, government sponsors have established various projects and test facilities on this property. In recent years, the Laboratory has updated and increased the utilization of this property, primarily for project use. Currently, MIT LL occupies and maintains the 26 buildings on the Lexington campus, including the infrastructure and site elements. Total building area of the 26 buildings was 1,884,470 square feet, as provided by MIT LL.

The 26 buildings on the MIT LL campus include administrative/office buildings, laboratory buildings, warehouses, and support buildings. Most buildings include a combination of space use type. Overall space usage by type and percentage of the total area include: office space (21.7%), laboratory space (12.1%), special purpose space (23.9%), and building service areas (42.3%). The average age of the buildings at the time of this study was about 40 years. A distribution of the buildings and total building area by general age range is shown in below.





While a majority of the buildings are over 50 years old, the age of the total space falls generally in two ranges due to the construction of Building S and Building G (Parking Garage) in the early to mid-1990s.

GENERAL APPROACH

The purpose of the project was to provide accurate and consistent information to aid in appropriately allocating funding for facility major maintenance projects at MIT LL. The outcome of this project should not only support funding decisions to ensure proper prioritization of funds and ensure proper stewardship of the facilities, but should be considered a "rehabilitation" or "recapitalization" plan for the facilities' future. An underlying objective of the condition assessment project was to create a facility asset management plan that is: rational, repeatable, recognizable, and credible.

To achieve the desired outcome, FEA compiled a team of technical professionals to conduct assessments at MIT LL. The team was organized according to the project scoping items and personal areas of expertise to assess the following major building/campus systems: site, structural, roofs, exteriors, interior finishes, mechanical, electrical, plumbing, fire and life safety, and elevators (or conveying systems). A cursory review of the buildings for general compliance with the Americans with Disabilities Act (ADA) issues was also included.

The project team consisted of registered professional engineers, certified facility managers, certified energy managers, commissioning agents, and LEED accredited professionals. The on-site condition assessments were performed by FEA team members Ms. Rebecca Gutierrez, Mr. Mark Leeman, Ms. Laura Cavanaugh, Mr. Walter D'Ascenzo, Mr. Bradley Kondrach, Ms. Laurie Gilmer, Mr. Philip Winterland, Mr. Peter Madson, Ms. Mary Kate Toomey, Mr. Gordon Dowrey, and Mr. Jeffrey Hunt. FEA was also assisted by the following sub-consultants:

- Mr. James DiPaoli of Rolf Jensen & Associates (RJA); Fire and life safety consultant.
- Mr. Christopher Lynch of RJA; Fire and life safety consultant.
- Mr. Eric Morse of Lerch Bates; Elevator consultant.

During our site visits, FEA was escorted by maintenance and facility management personnel from MIT LL; who also provided information about the buildings. The FEA team members reviewed available drawings, building construction documents, operations and maintenance information, and interviewed MIT LL Facilities staff in order to gain a more comprehensive picture of the facility conditions.

FEA developed our facility condition assessment procedures and standards years ago based on ASTM Standards (ASTM E 2018-99 Standard Guide for Property Condition Assessments: Baseline Property Condition Assessment Process). While our approach incorporates, and typically exceeds, the current ASTM Standard, we have also refined the approach to meet guidelines and requirements set forth by government and institutional agencies and associations[1]. This process includes visual assessments and life-cycle analyses to determine capital expenditures related to deferred maintenance and capital renewal, as well as the determination of several standard indexes such as the facility condition index, renewal index, and facility operating index. Details of our methodology and approach are presented in the Supporting Information section of this report.

In addition to the assessment of individual buildings, relative comparisons of the system conditions between the buildings in the assessment are provided to allow MIT LL to compare results between facilities, and provide a decision framework for prioritizing repair decisions.

The opinions of costs included in our recommendations for replacements and repairs do not include monies that might be necessary to make programmatic renovations or changes to the buildings or the

[1] Including the Federal Real Property Council (FRPC), the National Research Council (NRC), Government Accounting Standards Board (GASB), Federal Accounting Standards Advisory Board (FASAB), and the Association for Higher Education Facility Officers (APPA).

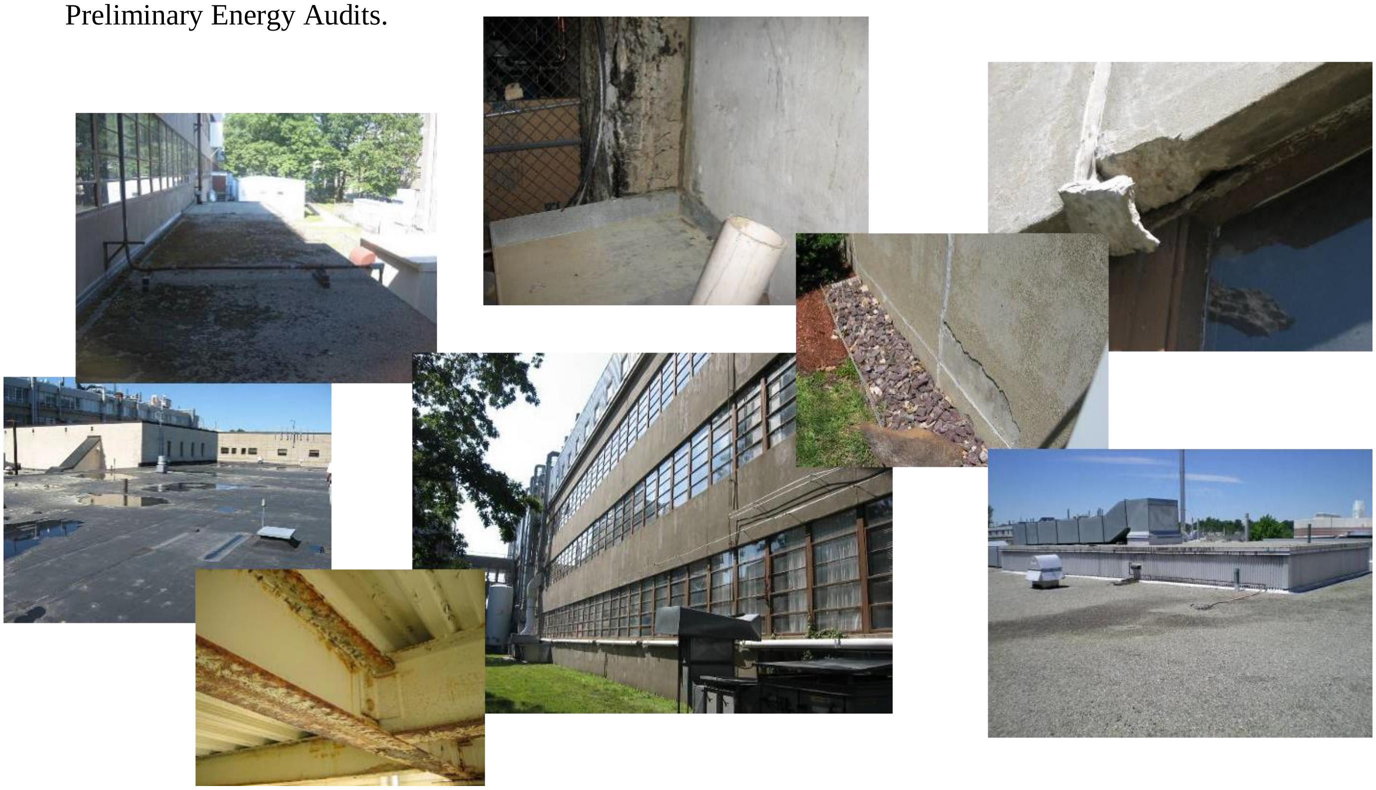
campus as a whole. These costs cannot be assessed on a pre-determined square foot basis, but require a detailed (functionality) evaluation on a case-by-case basis. A feasibility study conducted by an architect or consultant would be required to determine how best to achieve programmatic needs and what the associate costs might be at individual buildings or throughout the campus.

GENERAL FINDINGS

In general, the facility condition assessments revealed that an on-going visible and effective maintenance program is in effect throughout the MIT LL campus. While the buildings are aging, there has been a reasonable amount of renewal and improvement based on programmatic needs of the campus. Combined with the relative durability of construction of the buildings, the buildings are in a mixed overall condition. The Old Town buildings ranged from fair to poor condition, the Katahdin Hill buildings were in overall below average to poor condition, while South Lab was generally in good condition. Below is a general summary of the conditions and findings.

Substructure – The building foundations were in overall good condition; especially based on the age structures of many of the buildings; there was no evidence of major differential settlement or displacement in any of the buildings surveyed. However, we have a few recommendations regarding waterproofing basement walls, and an evaluation of the extent of building movement at Building LI.

Shell – Overall, the exterior elements of the building were in fair to poor condition for a majority of the buildings. We have recommended immediate repairs for many of the buildings relating to the exterior façade and painting practices. Roof replacements have been recommended in 2009, for Buildings A, C, D, E, FA, I, J, M, Annex 3, Balloon House, and the Lexington Field Station. Replacement of the windows for many of the older buildings has been included as an energy savings recommendation in the Preliminary Energy Audits.



Interiors – Floor, wall and ceiling finishes were generally in fair to good condition throughout the buildings we surveyed. Finishes were primarily carpet tile through the corridors and office areas, vinyl tiles in the laboratory spaces, and painted walls and suspended ceiling tiles throughout. Interior lighting was noted to be mostly T-8 and T-5 fluorescent fixtures throughout the buildings (retrofitted from the original T-12 fixtures). Replacement cycles of interior finishes are shown throughout the 20-year study period for each building.

Conveying – The elevators range in age, type, and condition throughout the campus. Some elevators have not been replaced since their original installations in the 1950s and 1960s. Most of our recommendations for the conveying systems include the upgrade or replacement of operating fixtures, controls, door equipment, cab, and pump unit during the 20-year study period.

Plumbing – The plumbing systems serving many of the buildings were in fair condition; the piping is over 40 to 50 years old in many of the buildings. Major recommendations for Buildings A, B, C, D, and L include the replacement of the domestic water heaters and steam heat exchangers due to age and possible deterioration of the cement lining. Cyclical recommendations throughout the study period included budgeting for domestic water and drainage system repairs every 10 years.

HVAC – The overall condition of the HVAC systems in the buildings depended mostly on the installation date of the equipment; older equipment being in poor condition, while newer units were observed to be in good condition. However, evidence of good maintenance practices was noted throughout. Major recommendations included items such as the repair or rehabilitation of air-handling units currently not in use, and replacements of aged equipment which have exceeded their expected service lives.

Fire Protection – It is our understanding that a majority of the facilities on this property, are owned by the United States Air Force, and as such, apply the United States General Services Administration (GSA) adopted codes and standards. Further, it is our understanding that many of the buildings were originally constructed in the 1950s and 1960s, and underwent subsequent renovation projects. It is not believed that a building code was adopted by the local jurisdiction at the original time of construction for many of the buildings. We noted several fire and life safety issues throughout each building surveyed. Many of these issues can be corrected with nominal effort and funds; however we noted some common capital expenditure projects that are recommended for correction immediately. These include the installation of sprinklers in areas with electrical equipment, install fire stop systems at all unprotected penetrations of fire barriers, and widen exit door widths at stairwell door of less than 28 inches.

Electrical – Overall, the electrical service for the buildings was aged, but in operating condition. We recommend an electrical preventive maintenance program be established for all the buildings, and should be performed every three to five years by a licensed electrician. Several buildings surveyed had instances of clearance and storage issues in several areas which are in conflict with the National Electrical Code (NEC) for personal safety. We recommend these clearance and storage issues are corrected immediately.

RISK ASSESSMENT

The approach followed for the facility needs assessment for MIT LL was a combined comprehensive condition assessment and life-cycle analysis. The condition assessment consisted of conducting visual assessments of the building systems, reviewing maintenance and repair histories, and interviewing facilities staff familiar with the maintenance and upkeep of the buildings. The results of the assessments identified specific short-term and anticipated long-term capital needs, which in turn generated prioritized projects necessary to bring the buildings back to an acceptable condition to meet current functional program requirements.

Condition Index

The results of the assessments also generated an estimate of annual capital requirements for reinvesting into the facilities to maintain or improve overall conditions. Short-term needs were used to calculate a facility condition index (FCI). This is discussed more in the section **COMPARISON OF FINDINGS**.

The deferred maintenance costs indicate immediate capital needs based on identifiable deficiencies or defects in the building systems. For our assessment and analysis, we have defined DM as the total expenditures recommended during the first five years of the study.

Condition index data, together with other facility information are used in the evaluation of alternatives to maintain, repair, replace, or do nothing to each building. These include:

- ***Space utilization*** – The capacity of the building based on people – Is the space under- or over-utilized?
- ***Building functional suitability*** – The ability of the building to meet the space, layout, adjacency, technology readiness, and design requirements to support programs housed in the building.
- ***Building mission dependency*** – The criticality of the building to meet the mission of MIT LL. This is typically either in the form of a Mission Dependency Index (MDI) or Asset Priority Index (API).
- ***Building energy performance*** – Considers the operating performance and efficiency of the building with respect to new high-performance building standards. Older buildings typically have lower energy performance ratings unless major capital investments have been made to lighting and HVAC systems.
- ***System functional risk*** – Overall age/remaining service life of the building systems and the potential risk associated with systems ability to meet functional needs or cause disruption to programs. This considers the risk of system failure, potential downtime, obsolescence, increased cost of repairs, and ability to meet load requirements.

Building Service Life and System Risk Analysis

To address the system functional risk we started by looking at the overall age of the building systems and renovations/additions to each of the buildings. We considered both standard design life data from the General Services Administration (GSA) and Department of Energy (DOE), and expected useful life (EUL) data from the Department of Defense (DOD) and RS Means cost estimating data. Industry standard EUL data used for the analyses are as follows:

- Substructure = 75 years
- Building Envelope = 50 years
- Roofing Systems = 15 years
- Interior Finishes = 10 years

- Conveying Systems (Elevators) = 25 years
- Plumbing Systems = 40 years
- HVAC Systems = 20 years
- Fire Protection Systems = 20 years
- Electrical Systems = 40 years

We also incorporated standard system degradation curves linked to the EUL to determine where each system fell on the degradation curve. If the system had not reached 75% of its EUL it was given a rating of low risk (risk level = 1 'green'). If the system was within 25% of its EUL it was considered moderate risk (risk level = 3 'yellow'). Once a system reached its EUL or beyond it is considered high risk (risk level = 5 'red').

Below is a portion of the risk assessment for the buildings at the MIT LL campus. The complete risk assessment summary can be found in Appendix B.

High Risk 🔴 Medium Risk 🟡 Low Risk 🟢		BUILDING SERVICE LIFE and SYSTI									
		SUBSTRUCTURE		SHELL				INTERIORS			
		Basement Constr.		Exterior Envelope		Roofing		Interior Finishes		Conve	
		Risk	Risk Level	Risk	Risk Level	Risk	Risk Level	Risk	Risk Level	Risk	Ri
Expected Useful Life (EUL)		75		50		15		10		25	
Building A	58	🟢	1	🟡	3	🟢	1	🟡	3	🔴	
Building P	35	🟢	1	🟢	1	🟢	1	🟡	3	⚪	
Building B	58	🟢	1	🟡	3	🟢	1	🟡	3	🔴	
Building K	58	🟢	1	🟡	3	🟢	1	🟢	1	⚪	
Building C	58	🟢	1	🟡	3	🟡	3	🟡	3	🔴	
Building D	58	🟢	1	🟡	3	🟡	3	🟢	1	🔴	
Building E	58	🟢	1	🟡	3	🟡	3	🟡	3	⚪	
Building M	24	🟢	1	🟢	1	🟡	3	🟡	3	🟡	
Building F	53	🟢	1	🟡	3	🟢	1	🟡	3	🔴	
Building FA	46	🟢	1	🟡	3	🟡	3	🟢	1	🔴	

The Total Building Risk Level is a weighted average of the system risk levels. The weighting considers the potential impact to health and safety of building occupants and operation of critical programs due to failure of the system, as well as increased maintenance and repair costs for aging systems. The potential failure of building services (HVAC, electrical, and life safety systems) would have the highest potential impact on programs and occupants.

Comparison of Findings

During our assessments, FEA team members made visual and cost comparisons of the conditions at each building. For the 26 buildings plus the site systems we identified approximately **$90.6M** in DM. DM for this project was defined as repairs or replacements that should have been completed already, and are recommended for completion during the first five years of the study, including any asbestos-containing material (ACM) and polychlorinated biphenyls (PCB) abatement that may be necessary.

Building E was identified to require the largest amount of deferred maintenance expenditures, in comparison to the other 25 buildings. Building E deferred maintenance totaled about **$11.8M**, which is approximately **13%** of the total deferred maintenance for the buildings ($88.8M).

Building	Deferred Maintenance (DM)	% of Total DM
Building E	$11,752,584	13%
Building D	$9,824,304	11%
Building C	$9,817,549	11%
Building B	$7,940,065	9%
Building A	$7,831,104	9%
Building J	$6,322,577	7%
Building S	$6,012,277	7%
Building L	$5,529,400	6%
Chilled Water Plant	$3,879,129	4%
Building I	$3,758,090	4%
Building ML	$2,443,321	3%
Building F	$2,020,337	2%
Building LI	$2,002,590	2%
A-Cafeteria	$1,915,745	2%
Building V	$1,765,634	2%
Building FA	$1,492,406	2%
Annex 6	$803,188	1%
KH - 1	$780,613	1%
Annex 3	$759,014	1%
Lexington Field Station	$494,819	1%
Building M	$465,670	1%
Building G (Parking Garage)	$445,230	1%
Building K	$279,345	0%
Annex 4	$227,237	0%
Building P	$134,062	0%
Balloon House	$126,431	0%
Total (Buildings)	**$88,822,721**	
Site Systems	$1,739,214	-
Total (Campus)	**$90,561,935**	

The total expenditures recommended during the 20-year study period for Building S is the highest total across all assessed buildings. This is mainly due to the large building area, and number of major systems such as the roofs and mechanical equipment that will need to be replaced over the study period.

Building	Expenditures During 20-year Period	Total Expenditure Cost per Square Foot
Building S	$24,920,394	$49
Building A	$17,240,829	$218
Building C	$17,045,522	$122
Building D	$14,640,976	$119
Building E	$14,597,421	$238
Building B	$13,292,845	$132

Building ML	$12,029,635	$129
Building J	$9,874,073	$132
Building L	$9,704,169	$102
Chilled Water Plant	$9,308,058	$480
Building I	$6,520,332	$132
Building F	$4,667,767	$103
Building LI	$3,884,303	$96
Building FA	$3,781,913	$78
A-Cafeteria	$3,288,855	$171
Building V	$3,188,410	$124
Building G (Parking Garage)	$1,593,036	$6
KH - 1	$1,567,645	$75
Annex 3	$1,400,153	$113
Annex 6	$1,298,245	$169
Building M	$1,015,706	$199
Lexington Field Station	$828,653	$45
Building K	$514,829	$216
Annex 4	$365,895	$122
Building P	$273,240	$184
Balloon House	$208,592	$211
Total (Buildings)	**$177,051,494**	**$94**
Site Systems	$6,052,721	
Total (Campus)	**$183,104,215**	

Other buildings that show high expenditure totals included Building A, B, C, D and E. Building A total expenditure costs are high due to the building housing the main security system for the MIT LL campus; therefore, the cost to upgrade and replace the main system components have been associated with Building A. Buildings B, C, D, and E total results were high mainly due to the aged and complex mechanical and electrical equipment. The configuration and placement of many of the systems will require added costs to replace.

The capital expenditure forecast summary of all facilities assessed is provided in Appendix C (11x17 folded pages).

Several indices and ratios were compiled to aid in the comparison of field findings and building conditions. Total net present value cost estimates have been used to determine total DM, FCI, and annual capital renewal expenditure values.

Facility Condition Index

One of the most commonly- and widely-used benchmarks produced from facility condition assessment data is the Facility Condition Index (FCI). The FCI was developed by the National Association of College and University Business Officers (NACUBO) in conjunction with the Association of Higher Education Officers (APPA) and is a parametric tool used to relatively compare building conditions. It has been broadly accepted, not only in the institutional environment, but across government agencies as well[2].

[2] The Federal Real Property Council 2008 Guidelines for Real Property Inventory Reporting and the FY2007 Federal Real Property Report (May 2008) list the Condition Index (CI) as a required data element and performance measure.

Government agencies report the Condition Index (CI) as a percentage out of a 100%, whereas educational institutions typically report the FCI as a decimal. Essentially, the two indexes are the same.

Educational (NACUBO/APPA)

The FCI is calculated by dividing the total cost to remedy DM (which has been defined as repairs or replacements that should have been completed already, summed over the first five years of the study period), and deferred replacement deficiencies for the building by the Current Replacement Value (CRV) of a building. The formula to calculate the index is:

$$\text{FCI} = \frac{\text{DM}}{\text{CRV}}$$

For educational performance measurement, a lower FCI represents a better condition of the building or asset.

The Current Replacement Value (CRV) is considered the approximate value, in current dollars, to replace a building. CRV is defined (by Association of Higher Education Facility Officers, APPA) as the total expenditure in current dollars required to replace a facility to meet current acceptable standards of construction and comply with regulatory requirements. The CRVs are based on the features and construction types of commercial facilities provided in the RS Means Square Foot Costs 2008 Edition and construction data provided by MIT LL.

The CRV for each building was calculated by multiplying the area (in square feet) of each building (designated SF in the formula below) by the expected cost per square foot to construct a similar building. Therefore, the calculation for CRV is represented by the following formula:

$$\text{CRV} = \text{SF} \times \frac{\text{Cost}}{\text{SF}}$$

The following table summarizes the values for the costs per square foot for each building, as well as the CRV based on the gross building square footage provided by MIT LL.

Building	Cost per SF	Current Replacement Value (CRV)
A-Cafeteria	$180	$3,462,840
Annex 3	$240	$2,978,880
Annex 4	$240	$717,120
Annex 6	$240	$1,847,040
Balloon House	$150	$148,200
Building A	$292	$23,140,708
Building B	$292	$29,375,200
Building C	$292	$40,826,564
Building D	$292	$35,936,148
Building E	$292	$17,902,228
Building F	$292	$13,281,036
Building FA	$292	$14,149,152
Building G (Parking Garage)	$60	$17,322,900

Building I	$292	$14,413,120
Building J	$292	$21,820,284
Building K	$295	$704,460
Building L	$292	$27,787,304
Building LI	$292	$11,844,980
Building M	$110	$560,670
Building ML	$400	$37,335,200
Building P	$100	$148,500
Building S	$292	$148,240,516
Building V	$240	$6,187,440
Chilled Water Plant	$1,000	$19,392,000
KH - 1	$292	$6,121,488
Lexington Field Station	$125	$2,314,750
Total		**$497,958,728**

Facility Condition Index versus Level of Service

There have been multiple published standards for qualifying the FCI values and ranges in terms of poor to good.

The Association of Higher Education Facility Officers (APPA) Maintenance Levels of Service (APPA's Maintenance Staffing Guidelines, 2002) correlates one aspect of a facility's level of service by the computation of the FCI. APPA's Levels of Service (LOS) for Maintenance Services is provided for reference in Appendix D.

According to APPA, a LOS that is considered a Level 1, or Showpiece Facility, would have an FCI of less than 0.05. A Level 5 LOS, would have an FCI of greater than 0.50 and would be considered to be managed by Crisis Response. Levels 2 through 4 fall in between, with respective ranges of FCIs.

However, FCI was defined by NACUBO as a relative term for the college and university community, and likewise APPA prescribed the LOS scale the college and university community. Although this may be applicable to some college and university campuses, these relative measures must be viewed in relation to the inventory of buildings to which they are applied and possibly modified to best represent the assessed inventory.

For the facility inventory assessed in this project assignment, FEA reviewed the conditions of the buildings relative to the calculated FCIs and adjusted the LOS scale so that it reflected our professional opinion of the observed conditions and level of service for the buildings assessed by FEA. After our review of the overall facility conditions and calculation of the corresponding FCIs for the assessed buildings, FEA suggests the following correlation of FCI to LOS for the buildings assessed:

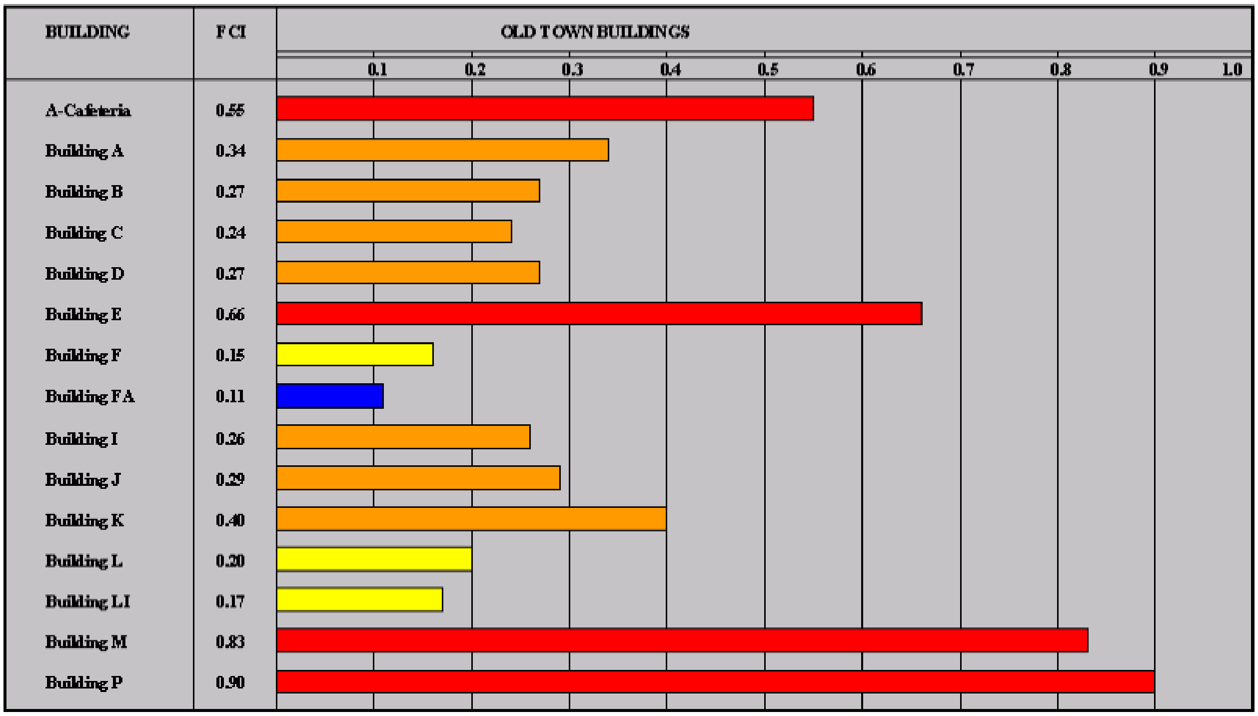
	EXCELLENT	GOOD	FAIR	BELOW AVERAGE	POOR
Description	State-of-the-Art Maintenance	High-Level Maintenance	Moderate Level Maintenance	Moderately Low-Level Maintenance	Minimum-Level Maintenance
Level	1	2	3	4	5
FCI	< 0.03	0.03 - 0.14	0.15 – 0.20	0.21 – 0.50	> 0.5
No. of Buildings (24 total) *	0	4	4	11	5
Area (SF)	0	670,431	200,602	618,087	88,117
% of Total Area	0%	43%	13%	39%	6%

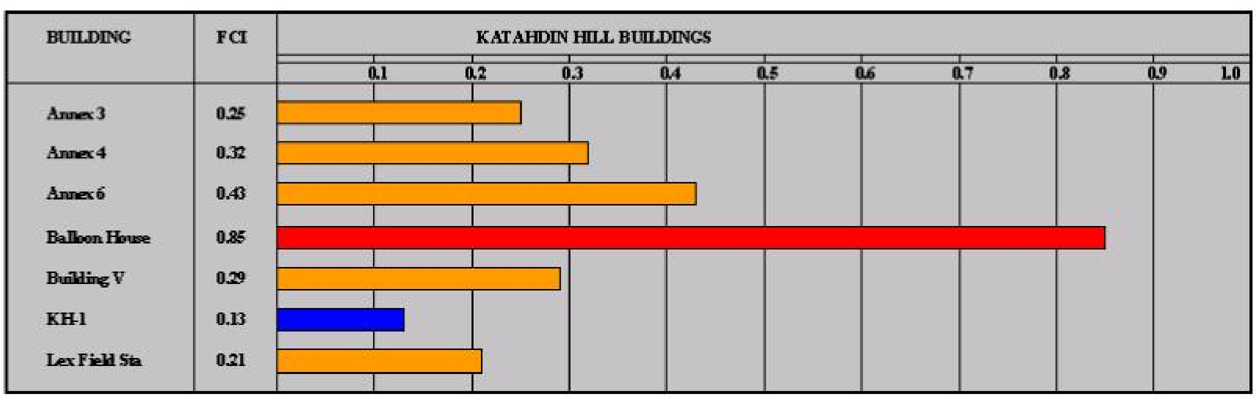
* Total number of buildings, total area (SF), and percentage of area does not include Building G or the Lexington Field Station.

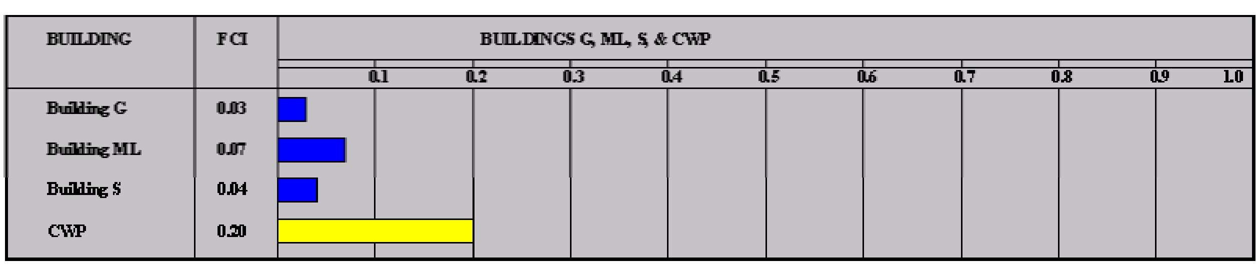
The above correlation is applied in the following table, which summarizes the CRV, DM, and FCI for each building that was assessed. The buildings are listed in order of lowest FCI to highest FCI. The color code follows our suggested correlation of APPA's LOS for Maintenance to the MIT LL inventory.

Building	CRV	DM	FCI
Building G (Parking Garage)	$17,322,900	$445,230	**0.03**
Building S	$148,240,516	$6,012,277	**0.04**
Building ML	$37,335,200	$2,443,321	**0.07**
Building FA	$14,149,152	$1,492,406	**0.11**
KH - 1	$6,121,488	$780,613	**0.13**
Building F	$13,281,036	$2,020,337	**0.15**
Building LI	$11,844,980	$2,002,590	**0.17**
Building L	$27,787,304	$5,529,400	**0.20**
Chilled Water Plant	$19,392,000	$3,879,129	**0.20**
Lexington Field Station	$2,314,750	$494,819	**0.21**
Building C	$40,826,564	$9,817,549	**0.24**
Annex 3	$2,978,880	$759,014	**0.25**
Building I	$14,413,120	$3,758,090	**0.26**
Building B	$29,375,200	$7,940,065	**0.27**
Building D	$35,936,148	$9,824,304	**0.27**
Building V	$6,187,440	$1,765,634	**0.29**
Building J	$21,820,284	$6,322,577	**0.29**
Annex 4	$717,120	$227,237	**0.32**
Building A	$23,140,708	$7,831,104	**0.34**
Building K	$704,460	$279,345	**0.40**
Annex 6	$1,847,040	$803,188	**0.43**
A-Cafeteria	$3,462,840	$1,915,745	**0.55**
Building E	$17,902,228	$11,752,584	**0.66**
Building M	$560,670	$465,670	**0.83**
Balloon House	$148,200	$126,431	**0.85**
Building P	$148,500	$134,062	**0.90**
	$497,958,728	**$88,822,721**	**0.18**

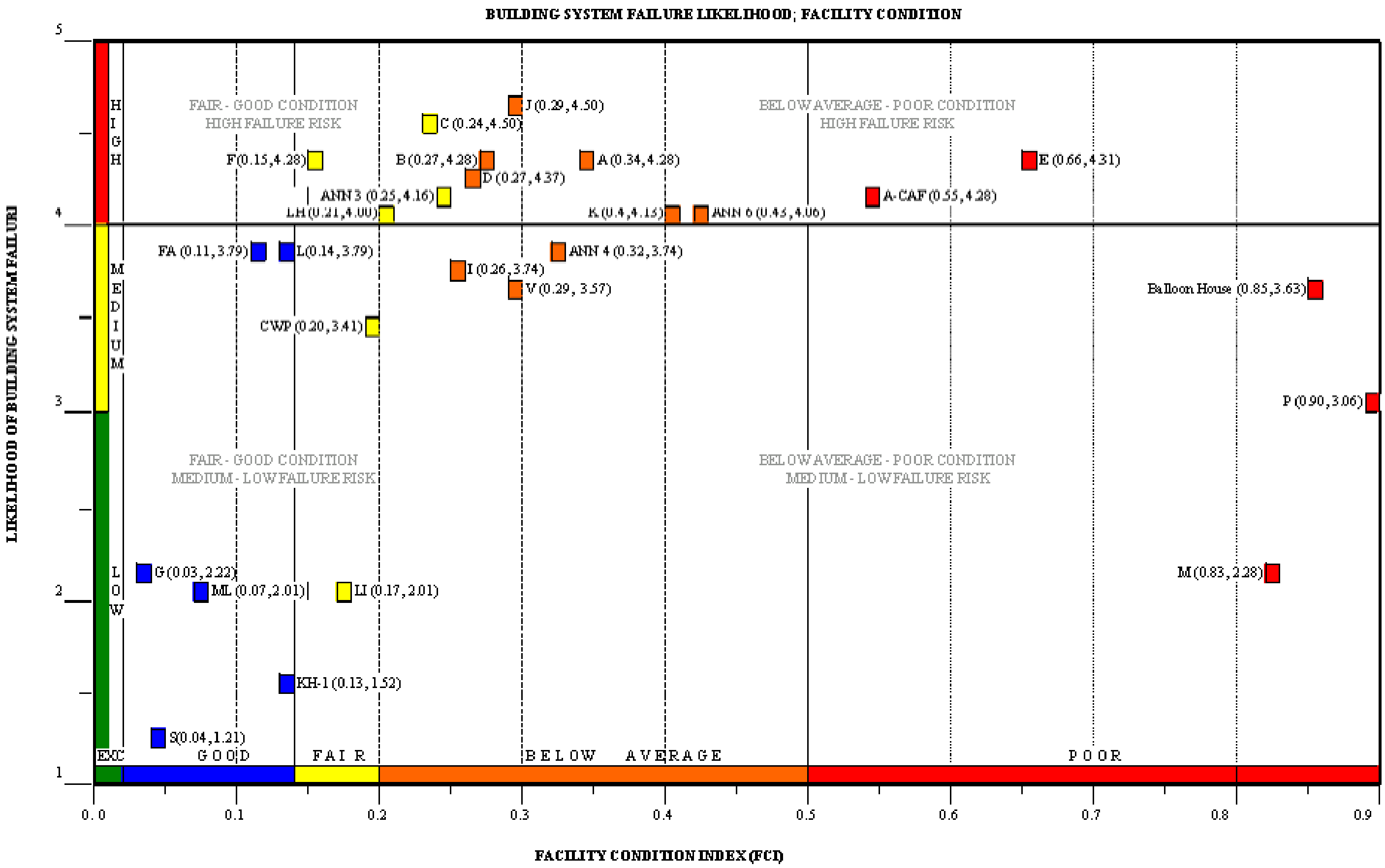
The MIT LL campus is divided into different areas, referred to as Old Town, Katahdin Hill, and South Lab (as shown in the Executive Summary). Based on the results of the facility condition assessment, overall the Old Town buildings ranged from fair to poor condition, the Katahdin Hill buildings were in overall below average to poor condition, while South Lab was generally in good condition. The graphs below show the three areas and their associated buildings; the Chilled Water Plant was incorporated into the South Lab graph. Larger views of these bar graphs can be found in Appendix A.







To compare the calculated FCIs, or conditions of the buildings, as well as the risk assessment (or likelihood of building system failure) as described above, from building-to-building, the following scatter plot was created. Nearly half of the total buildings on the MIT LL campus are categorized as "High Failure Rate". This is mainly due to the age of these buildings. A larger view of this comparison scatter plot can be found in Appendix A.



ANALYSIS OF RESULTS

The Federal Facilities Council (FFC) reported an optimal range of Maintenance and Repair (M&R) budgeting to be in the range of 2 to 4% of the current replacement value (CRV) for facilities. This includes the capital and operational expenses, as they relate to routine maintenance, repairs, and replacements. Below is a list of expenses that should be included in the M&R budget, as defined by the FFC:

- Recurring, annual maintenance and repairs including maintenance of structure and utility systems
- Roofing, chiller, boiler replacements, electrical, lighting, etc. *
- Preventive maintenance
- Preservation / cyclical maintenance
- Deferred maintenance backlog *
- Service calls

It should be noted that the items above identified with an asterisk (*) are those expenses that have been assessed and reported on by FEA as part of our Facility Condition Assessment. The remaining items listed above are to be provided by MIT LL to be used in our baseline analysis.

Below is a summary of the capital and operating budgets for the MIT LL campus as of 2007:

1. Capital Budget
    a. $17 million
    b. Includes $13 million for Building S lease
2. Operating Budget
    a. $33 million
    b. Includes $11 million for Salaries

Based on this information, it is difficult to determine the M&R budget for MIT LL as defined by the FFC. Once additional details of the budget are provided to FEA we will be able to report a comparison of the optimal range of annual maintenance and repair expenditures, as defined by FFC, (as well as the annual average of recommended expenditures as reported by FEA) versus what budgeting efforts are currently followed at MIT LL.

Nonetheless, our FCA for the 26 buildings plus site systems shows that approximately **$8.9M for the 26 buildings,** and **$9.2M for the campus (buildings and site systems)** per year should be budgeted on an annual basis for deferred maintenance and capital replacements of the assessed systems. The total CRV for these 26 buildings is **$498.0M**. FEA's recommended expenditures, on an annual basis, are approximately **1.7%** of the total CRV of the 26 buildings.

We recognize that this percentage is close to the lower end of the FFC recommended 2 to 4% (of M&R expenses versus total CRV). It must be understood that the **$8.9M** for a recommended annual budget only includes the two items listed above with an asterisk. The remaining listed items must be added to FEA's recommended deferred maintenance and capital replacement total to gain a complete picture of the M&R budget comparison to the total CRV of the buildings.

BENCHMARKING

FEA performed a literature search and reviewed previous project data of government and universities to evaluate condition indexes for benchmarking purposes. We also narrowed our review to FFRDC facilities and government laboratories for more specific and relevant comparisons. The results of our preliminary benchmark analysis are presented herein. We have categorized the results by facility type and source for ease in comparison.

Educational Facilities

APPA's Facilities Performance Indicators Report based on their Facilities Core Data Survey indicates that the average FCI for research institution facilities[3] is **8.7%**, or **0.087**. This includes all building types (i.e., administrative, laboratory, and support buildings). The report also indicates an average FCI value for buildings in the northeast region of **8.5%**, or **0.085**.

[3] Doctoral/Research Universities – Extensive: These institutions typically off a wide range of baccalaureate through doctorate programs.

One note of caution when using these data for benchmarking purposes, an APPA Past President and former university physical plant director familiar with the Facilities Core Data Survey processes and results warned of some variances. The data reported often contains not only deferred maintenance items, but often planned capital improvements that had already been budgeted. This would tend to drive the FCI values higher (poorer condition) than the actual conditions.

Government Facilities

There is limited public information, as well as a widely varying data set for government condition performance measures at this point. General information published in the FY2007 Federal Real Property Report indicates a range in FCI of **0.088** for hospitals and laboratories to **0.268** for offices (FRPC, 2008).

Unpublished data from the General Services Administration (GSA), collected via a benchmarking project, also provided a source for relative comparison. Condition assessment data were collected from several government agencies and used to develop an algorithm for estimating condition indexes based on building age, renovations, and maintenance. Data from over 80 laboratory facilities was included in the data set. The data reveals that the laboratory FCIs were among the lowest in the overall data set of facilities and typically less than **5%**.

FEA also completed a number of facility condition assessments at various Air Force facilities across the United States. Similar scope projects resulted in a range of assessment data. Few of the buildings were actually Research and Development type categories.

Federally Funded Research and Development Centers

FEA performed a cursory review of the 36 Federally Funded Research and Development Centers (FFRDC) listed by the Federal Government to obtain condition data for benchmarking. The 36 FFRDCs generally fall into the following agencies:

- Department of Defense
- Department of Energy
- Department of Health and Human Services
- Department of Homeland Security
- National Aeronautics and Space Administration
- National Science Foundation
- Nuclear Regulatory Commission
- Department of Transportation
- Department of the Treasury

There is very limited published data regarding deferred maintenance and condition indexes for FFRDCs. However, we did obtain and review some data based on requests, as well as compile data FEA had collected and analyzed in previous projects. Much of this data is confidential and restricted for use based on contracts. However, we can share the overall results without specifically identifying agency-specific results.

Condition index data was compiled from the following facilities:

- U.S. DOE, National Nuclear Security Administration
  - Lawrence Livermore National Laboratories
  - Los Alamos National Laboratories
  - Y-12 Oak Ridge National Laboratory
- C3I FFRDC, Bedford, MA, San Diego, CA, and McLean, VA (MITRE Corp.)

- Center for Naval Analyses (The CNA Corporation), Alexandria, VA
- National Institutes of Health, National Cancer Institute, Frederick, MD
- NASA, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA
- U.S. Army Research Laboratory, Adelphi, MD

A review of available information indicates that condition index data for these facilities ranges from an FCI of **0.08** to **0.01**. However, the FCIs for these FFRDCs are based on slightly different definitions of DM, and the range of years to which deferred replacements or repairs is considered. DM for this project was defined as repairs or replacements that should have been completed already based on age and condition, and are recommended for completion during the first five years of the study. The intention of this definition is to capture building system replacements or repairs necessary to bring the buildings back to the desired maintenance level set by MIT LL. Therefore, there is not a valid comparison between MIT LL and the other FFRDCs. Currently, FEA does not have details from the other FFRDCs to adjust the FCIs to compare with MIT LL data.

Evaluating the DOD FFRDC data was not relevant due to the fact that the DOD facilities are required to only report condition indexes to the FRPC as 30%, 70%, 85%, or 95%, and not on an overall scale of 0% to 100%. DOD facilities do not report exact calculated values, but instead report the percentage ranges above. Therefore, it is difficult to try to compare the conditions of DOD facilities since specific values are not available.

NASA condition assessment data was developed using an alternative approach to calculate deferred maintenance and condition indices. The approach used for NASA facilities followed a streamlined condition assessment process termed the Backlog of Maintenance and Repair (BMAR) approach (Geldermann, 2007). Our experience has been that the BMAR approach tends to be conservative in calculating CI values since it is based on a system-level assessment and generalized condition ratings.

In summary, at this point there may be little value in benchmarking with other FFRDCs due to limited data and inconsistent condition assessment approaches. There are efforts underway by the FRPC to collect more consistent data over time by developing data collection and reporting standards. The available data reviewed and compiled by FEA does provide close agreement to the results determined in this study. However, it would be difficult to defend a position of better or worse conditions based on specific data.

We will provide some specific contacts at some of the FFRDCs, including the Army Research Laboratory, NASA Jet Propulsion Laboratory, and Lawrence Livermore National Laboratories, should MIT LL wish to follow-up in person.

SUPPORTING INFORMATION

BACKGROUND

The topic of facility investments and condition assessments remains at the forefront of not only the facilities executive's world, but organizations and institutions in general. Organizations across the U.S. are facing the largest collection of aging buildings ever encountered. Deferred maintenance backlogs continue to grow at unprecedented rates, while the toll it has taken on facilities is reaching critical levels. You need not look far to find the research and data to support the need for better facility capital investments and asset management (NRC.1998, NRC.2002, and NRC.2004) (IFMA. 2007) (APPA.2002) (GAO.1996) (FFC.1998) (GASB. 1999) (FFC.2001) etc.

Findings and recommendations of best practices in facilities asset management (and facility condition assessments) have been researched and reported by the National Research Council independent of the specific approach. Key components to an asset management program include (NRC, 1998):

- Standardized documented process that provides accurate, consistent, and repeatable results.
- Detailed ongoing evaluation of real property assets that is validated at predetermined intervals.
- Standardized cost data based on industry-accepted cost estimating systems (repair/replacement)
- User-friendly information management system that prioritizes DM and CR.

The outcome of this project should not only support funding decisions to ensure proper prioritization of funds and ensure proper stewardship of the facilities, but should be considered a "rehabilitation" or "recapitalization" plan for the facilities' future. The primary objectives and high-level benefits of preparing facility asset management plans by conducing baseline FCAs include:

- Obtaining objective and credible data to make the rational and informed facilities investment decisions through prioritizing needs.
- Streamlining facilities management processes and reducing the total cost of ownership.
- Improving the condition of facilities.
- Extending the life of assets through proper maintenance and repair funding and decisions.
- Minimizing safety and security risks at facilities.
- Minimizing the disruption to customers (passengers) and tenants caused by facility system failures by maximizing critical system reliability.
- Enabling optimal use of facilities and infrastructure in support of the agency/organizational mission.
- Finally, improving overall stewardship of facilities and maximizing return-on-investment for stakeholders.

The most important factor to achieve success in assessing the condition of your facilities is to evaluate your objectives without bias. There are a multitude of reasons to conduct FCAs. Some of the more common outcomes include:

- Developing and justifying long-term or short-term capital budgets;
- Identifying backlogs of deferred maintenance (sometimes for regulatory reporting purposes);
- Identifying and prioritizing specific capital project needs;
- Independently validating capital improvement project requirements; and
- Verifying equitable distribution of capital funds among multiple and independently operated facilities.

By amassing and analyzing defensible physical infrastructure data, facilities executives are equipped with decision support tools that enable accurate estimates of currently deficient buildings, systems or components, and the forecasting of renewal costs over time. At a more detailed level, FCAs enable and support:

- Maintenance and operations decisions regarding repairs & replacements,
- Prioritizing our deferred maintenance backlog & setting short & long term goals,
- Long term planning of major building component replacements,
- Capital planning of major renovations,
- Five-year budget models to match funding levels with established goals.

Users of these FCA data and capital planning software tools include operations & maintenance staff, architects, engineers & planners, safety, health & risk management departments, and facility administrators and executives.

Efforts to formalize and improve facilities asset management practices in the public sector have been similar to the efforts by higher education facilities managers. A well documented summary of the issues present in federal facilities asset management has been presented in two publications by the NAS/NRC for the Federal Facilities Council (FFC). The publications include:

- Stewardship of Federal Facilities: A Proactive Strategy for Managing the Nation's Public Assets
- Investments in Federal Facilities: Asset Management Strategies for the 21st Century

Initiatives to formalize facilities asset management in the public sector have also resulted in the development of standards and promulgation of regulations. Three relevant standards/regulations include: 2008 Guidance for Real Property Inventory Reporting (FRPC, 2008), Modified Methods to Facility Asset Depreciation (GASB 34, 1999), and the Executive Order for Real Property Asset Management (EO 13327, 2004). Important aspects of these guidance documents have been incorporated into this study.

CONDITION ASSESSMENT FACTORS

Discussions were held throughout the Facility Condition Assessment project between FEA and MIT LL key stakeholders. Many conversations focused on the cost factors to apply to each recommendation (or project) as well as the Current Replacement Value (CRV) of each building used for condition comparisons.

Below is a breakdown of cost assumptions used in determining FEA's opinions of costs for the surveyed buildings:

<u>FEA Condition Assessment</u>

- Project difficulty (i.e. layering of piping, equipment/penetrations on roofs)
- Project location cost (metro Boston, Massachusetts)
- Open-shop / daytime work
- Hazardous materials, abatement (if documented and reported to FEA)

MIT LL reported that several factors need to be considered for increases in renovations and construction projects at the MIT LL campus. Based on provided information, the cost increase applied to all project over the 20-year period equaled approximately 53%. The following list summarizes these factors.

<u>MIT LL Cost Multipliers</u>

Davis Bacon Act (prevailing wages)	10%
Difficulty (due to nature of campus/building systems)	10%
General Contractor Fees, Overhead and Profit	23.4%
Contingency	10%

In addition, MIT LL provided FEA with abatement estimates for asbestos-containing material (ACM) and polychlorinated biphenyls (PCB) removal for certain buildings. The cost for abatement in these buildings was applied to the capital expenditure forecasts in Year 1. Therefore, the abatement costs are included as part of the total deferred maintenance for the facility. The ACM and PCB abatement estimates were applied subsequent to the above cost multipliers.

ACM abatement	27.6% average based on building area
PCB abatement	19.1% average based on building perimeter

SCOPE OF SERVICES

MIT LL engaged FEA to provide a Facility Condition Assessment and Preliminary Energy Audits for 26 buildings located at their campus in Lexington, MA. FEA has partnered with MIT LL key stakeholders throughout the project to enhance communication, teamwork, and project management.

<u>Approach and Methodology</u>

FEA provided our services and expertise to initiate and facilitate internal discussion by MIT LL, rather than to simply document, analyze, and recommend revised processes. FEA's role was to provide structure and guidance to the effort.

FEA followed the conceptual outline shown in Figure 1. Partnering Sessions (and/or meetings) began with the identification of objectives and agreement on measures of success. With the outcome in mind, we moved on to analysis of what data would be required to develop our measures, and finally into data collection and analyses with an emphasis on clearly defining responsibility for both execution and communication at each stage. Underlying every meeting was a recognition that opened conversations about process, framed in the context of shared objectives, which can help to build a culture of trust and understanding within the MIT LL organization.

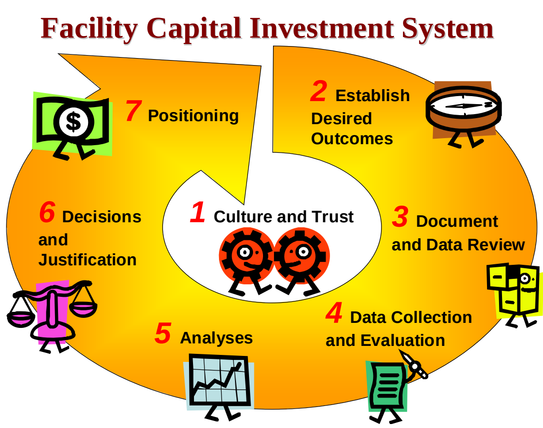
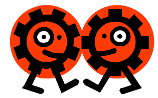


Figure 1: Systems Approach to Facility Capital Investment Planning

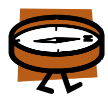
Step 1. Understanding MIT LL Culture & Establishing Trust



In the hundreds of Facility Condition Assessments we conduct each year, the most critical project aspects, which are often least understood, include Steps 1 through 3 of our system's approach. Many facility capital plans fail because the long-term needs are not truly understood, or there is a culture that prevents the implementation of the capital investment plan.

We aligned ourselves with the major stakeholders up front to lead a successful stewardship plan, and left MIT LL with a solid basis for capital budget justification, as well as financial forecasting tools to keep the information current over the life of the facilities. With our results, MIT LL had a project outcome to support a strategic plan for a "rehabilitation" or "recapitalization" for the facilities' future.

Step 2. Establish Desired Outcomes

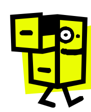


FEA met with MIT LL key stakeholders to:

- understand driving forces and the facility master plan
- establish desired outcomes of the capital investment plan
- develop needs prioritization schema
- develop key performance indicators (KPIs) for performance measurement
- establish agreement on philosophy of short- and long-term capital planning needs
- agree and build consensus on desired levels of service

We understand that although condition assessments seem typical and standard, the utilization of and expectations for use of the data for each client are different. We sent an advanced team to MIT LL to meet with key members of the MIT LL team in order to more fully understand the background, expectations, objectives, and use of our assessment data. FEA's team gained an understanding of the purposes and goals, obtained preliminary information useful towards achieving efficiencies in our efforts, and obtained information critical to refine our approach to provide useful information for the system.

Step 3. Document and Data Review / Pilot Study



Before we started with the actual analysis, we collected pertinent information about the 26 buildings in the assigned task. We reviewed existing system information and data that had previously been collected, collated information from reports that have been prepared by MIT LL and other consultants, and in cooperation with the various engineering and maintenance shops, identified types of equipment and associated attributes that needed to be collected.

Where available, the documentation reviewed included drawings, specifications, operating and maintenance manuals, previous reports, CMMS data, maintenance records, previous budgets, and facilities master plan. The team collected baseline data, existing drawings, and maintenance data in a systematic way to efficiently evaluate existing conditions.

The types of drawings / data we reviewed included, but were not limited to:

- Engineering studies
- Roofing inspections
- Previous assessment data
- Equipment lists from the CMMS

- Architectural drawings
- Structural drawings
- Civil engineering drawings
- Mechanical / Electrical / Plumbing drawings
- Fire Protection drawings

In tandem with our document and data review, FEA performed a pilot study of one selected building (Building D, as chosen by MIT LL) in order to better understand and define the necessary reporting requirements and access issues. After the pilot study, the necessary corrections were implemented prior to the full on-set of our remaining assessments.

Step 4. Data Collection and Evaluation

We worked with MIT LL to initiate the data collection, photographic documentation, and condition assessment as unobtrusively as possible throughout the MIT LL campus. Continuous quality control and quality assurance procedures were implemented to ensure the completeness, accuracy, and consistency of the data collected.

We performed visual assessments of above-ground, visible, and accessible interior and exterior components of the buildings for inclusion in the capital investment plan. The following major systems were included in our Baseline Condition Assessment, and also our Preliminary Energy Audit:

Architectural / Civil Systems

- **Site Systems** – The extent of site systems included roadways, parking lots, plazas, patios, courtyards, sidewalks, and underground utilities, etc. We observed the current condition of these features for evidence of visible deficiencies.
- **Structural Systems** – We observed exposed structural elements in the buildings and parking garage for visible signs of distress (differential movements/settlement, wall cracking, displacement, etc.) and reported our findings. Our scope did not include a review of original design assumptions or calculations or a completion of structural analyses or Probable Maximum Loss (PML) Studies.
- **Roof Systems** – We observed the current condition of the buildings' roof systems, accessories and details. We observed flashing and penetration details for condition and conformance with accepted practice. The evaluation included discussion of existing warranties, replacement costs and systems, and remaining useful life.
- **Building Exterior Elements** – We observed the current condition of the exterior wall, window, and door systems. Our observations were based on those conditions that could be observed from the ground and from the roof.
- **Interior Finishes** – We observed the current condition of the interior wall, ceiling, and floor finishes.
- **Accessibility Issues** – We conducted a cursory level site reconnaissance to observe major systems that may not comply with the applicable accessibility requirements. Accessibility issues are dependent upon the type of facility, ability of the owner to provide accommodation, extent of any renovations or repairs, and other factors that may vary considerably. Although FEA provided our opinion regarding these issues, we recommend consultation with counsel for clarification where required. Our observations regarding accessibility was limited to site and building common areas and did not include or extend to tenant spaces.

Mechanical/HVAC, Electrical, Plumbing (MEP) Systems

- **Mechanical/HVAC Systems** – We observed the age and condition of the heating, ventilating, air conditioning systems, building controls and related mechanical systems and commented on their condition and visible deficiencies. We noted any energy conservation issues we found and recommendations for improvements.
- **Electrical Systems** – We observed the age and condition of the electrical service entrances, grounding, electrical distribution systems, lighting, and emergency back-up systems and commented on their condition and visible deficiencies. The review included discussions of power utilities presently serving the buildings.
- **Plumbing Systems** – We observed the age and condition of the water service entrances, potable water distribution systems, sewer systems, gas distribution, and other plumbing components and comment on their condition and visible deficiencies.

Fire & Life Safety and Conveying Systems

- **Fire and Life Safety Issues** – We observed the age and condition of the fire and life safety elements and comment on their condition and visible deficiencies. The elements observed consisted of: structural fire protection, fire suppression systems, and fire detection and alarm systems.
- **Conveying Systems** – We observed the elevator equipment and controls in machine room, cab, and lobby to review typical conditions and to obtain general information regarding the age and type of equipment and to look for evidence of on-going maintenance. We reviewed available maintenance records and reports for the elevator equipment.

Preliminary Energy Audit

- We performed a preliminary energy audit at the MIT LL buildings in general accordance with the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) “Procedures for Commercial Building Energy Audits”, ‘Level 1 – Walk-Through Analysis’. Our Level I Analysis provided a preliminary energy audit that identified low-cost and no-cost measures and provided a list of potential capital improvements that merit further consideration.

The evaluations were visual in nature and not intended to be destructive to property in order to gain access to hidden conditions. We did not propose to expose any system members. We documented the type and extent of visually apparent defects in the systems in order to perform the condition assessments. As this scope of services was limited to visual observations, these assessments did not identify conditions hidden by interior finishes, exterior finishes or within any enclosed construction.

Consistent with standard condition assessment practices, FEA did not access all areas of the facilities, but endeavored to access a sample of the areas. As such, our report does not warrant or guarantee that the conditions noted in the areas observed will not vary from other areas not observed. In addition, our findings and recommendations are not based on a comprehensive engineering study. Our report is not intended to be a complete review of all systems or a check of design professional’s computations. Our observations and resulting report does not warrant or guarantee the performance of any building system or site improvement.

Our scope of services included only those specifically indicated. Our services did not include any environmental services such as sampling or testing of asbestos, lead-based paint, lead-in-water, indoor air quality, PCB’s, radon, mold, or any other potentially hazardous materials, air-borne toxins or issues not outlined in this scope of services. In addition, this assessment did not include identification of underground soils or identification or quantification of underground contaminants. However, FEA observed readily accessible areas to look for suspect asbestos-containing materials (ACM) and

polychlorinated biphenyls (PCB). FEA worked closely with MIT LL to access the building areas and systems. Our findings and recommendations were not based on a comprehensive engineering study.

Step 5. Analyses 

FEA delivered all data to MIT LL in flat file format using Microsoft Excel. The data was prepared in a readily-transferable format so that it could be input into our capital expenditure planning software program (ENVISAGE). ENVISAGE is a software tool that allows easy data entry of buildings, building systems, equipment/components, and capital projects. Cost modeling is flexible with ENVISAGE, allowing use of FEA internal unit cost database, RS Means, and other estimating data.

Step 6. Decisions and Justification 

We routinely evaluate system replacements with overhauls or upgrades to develop the best life-cycle solution. We know what elevator systems are obsolete and which are old but function well and have adequately stocked replacement parts. We will not rely solely on expected useful service lives as the trigger for including a capital project. We use a condition-based assessment approach combined with our expertise and familiarity with building systems and components to develop project lists. Replacement of existing systems, in kind, is not always the most appropriate solution to a repair/replacement requirement.

Many of the condition assessment projects that we perform for universities and government agencies require that project justifications for capital projects be developed and entered into a capital expenditure forecast. These project justifications typically require addressing several questions including: Why is the project needed? What is the priority of the project? What are the consequences if it is not undertaken or delayed? Who will the project impact? Will staff need to be relocated? And what alternatives were considered?

Answering these questions is part of our routine condition assessment. We utilize capital project justification forms to document the key factors to support the justification of each project. However, the consultant alone cannot fully answer most of these questions. Anyone that leads you to believe that they can is not fully addressing your needs from your perspective. MIT LL can use this information as a basis for long-term planning.

Step 7. Positioning (Strategic Planning) 

This step was crucial to support MIT LL in selling the long-term capital investment plan to senior management, or the Steering Committee. A capital expenditure forecast, designed to meet the needs of MIT LL, was provided to reflect and manage capital expenditures forecast over a 20-year study period. The capital expenditure forecast presented required and projected repairs/replacements. The capital expenditure forecast will identify those items that, in our opinion, require immediate repair or replacement, and those that can be normally anticipated to occur over the study periods. Our multi-year capital plans for each building and the site systems included the following:

- Information on deficiencies from the assessment
- Total deferred maintenance (DM), which is defined as the expenditures in Years 1 through 5
- Total expenditures during the 20-year study period

- A capability to sort the plan by several elements/fields to include, but not be limited to, priority category, deficiency type, and total cost.

METHODOLOGY OF CONDITION ASSESSMENTS

Standards for Building Condition Assessments

FEA developed and refined our building condition assessment procedures and standards in the commercial market before moving into institutional and government sectors years ago. Although our building condition assessment standards preceded the development of ASTM Standards (ASTM E 2018-99 Standard Guide for Property Condition Assessments: Baseline Property Condition Assessment Process), they incorporate, and typically exceed, the current ASTM Standard. We have worked closely with individuals on the Standards Committee in the past during the development of the ASTM Standards and still generally follow the ASTM Standards for most protocols. However, since the ASTM standard was developed by a committee of lenders and providers primarily servicing the commercial refinance market, we have found that strict adherence to the ASTM protocol does not meet typical expectations of an institutional owner such as MIT LL.

The primary criteria FEA applies in assessing the condition of a building system are our assessor's knowledge of expected service life of systems and components and the ability to recognize adequate maintenance. Our assessors have inspected millions of square feet of buildings, and gained a sense of what constitutes a proper initial specification and installation, proper maintenance, and the vagaries of environmental conditions. This sets us apart from firms who simply rely on published life expectancies. Although published sources are useful, they must be tempered by the experience of seasoned condition assessors.

Life Cycle Analyses

FEA has found that the proper timing and prioritization of capital expenditures often results in overall cost savings. As systems age, repair costs will increase until it becomes uneconomic to keep repairing obsolete components or systems. The following graph highlights the typical life-cycle cost trend for buildings, systems and components.

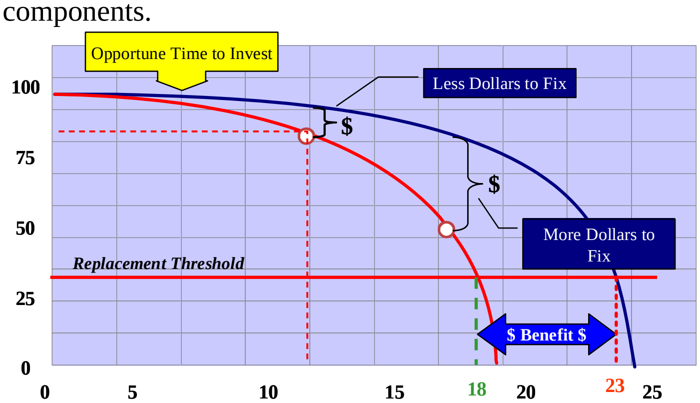


Figure 2: Life-Cycle Curve

Each type of building system has its own life cycle curve. The above curve represents a typical system such as a parking garage or roof system. Life cycle curves for other systems may vary considerably. FEA routinely evaluates life cycle curves of various buildings systems. We have experience of how these curves behave over time and knowledge of when appropriate actions should be taken. FEA specializes in identifying capital project solutions at the appropriate time in the life cycle of building

systems and components. Repairs and replacements at the appropriate time in the life cycle of a system can result in significant cost savings and cost avoidance.

Deferred maintenance includes systems and components that may have already passed the appropriate time for repair or replacement and may cost more to further extend or restart the life cycle curve. For example, based on a preliminary assessment, deferred maintenance costs may be calculated as the Year 1 cost ($20M) minus the anticipated average annual capital expenditures (say $7M), resulting an approximate deferred maintenance cost (say $13M). A more detailed condition assessment would identify the systems and components that require attention and more accurately project future capital expenditure needs. Identifying and acting upon this information should result in a reduction in the level of deferred maintenance and may also reduce long-term maintenance and repair costs.

Life-cycle Costing Evaluation Process

The most common method of managing budgets has been the component method. The amount allotted for a particular capital asset is often related to that asset's replacement value and anticipated life in relation to the total capital asset value of all the facilities' elements. The level of assessment is set so that each individual element is adequately funded when the time for replacement occurs.

To develop a budget, FEA observed and documented the condition of systems and assessed whether or not the systems were functioning properly, and when the systems may require replacement. FEA provided opinion of costs for replacements by taking into account reliability of currently in place systems, our experience with potential alternative systems, and the constructability of replacement systems, and consider the potential for unforeseen circumstances that are often encountered for similar systems in similar circumstances.

We looked at the predicted expenditures for each year of the study period, allowing us to look ahead for several years when large expenditures are likely. From this spending forecast we could determine if complete replacement of a component can be funded, or if a phased approach is required. Occasionally, replacement of a particular component may be hastened or deferred in order to more evenly distribute expenditures from year to year.

Methods of Determining Cost Estimates

FEA performs condition assessments on hundreds of facilities every year across the United States. During these assessments, we obtain cost estimates from local specialty contractors for repairs or replacements of many of the building’s systems and components. In addition, through our interviews with facility managers and reviews of maintenance files, we record actual historical repair and replacement cost data. Finally, our repair and restoration group and sub-consultants regularly prepare design drawings and project manuals, obtain contractor bids and provide construction management for hundreds of building restoration projects. These projects include parking garage repairs, roof replacements, exterior curtain-wall renovations, interior renovations, ADA barrier removal, mechanical/HVAC, electrical, and plumbing repairs, life safety upgrades, and elevator modernizations.

The actual cost data from previous projects is combined with our historical condition assessment data and recorded for use in rendering our opinions of cost for building system and component repair or replacement. The opinions of cost developed for most capital repair and replacement projects are generally for use in planning and scoping.

We also utilize RS Means Facilities Maintenance and Repair Cost estimating data, modified to reflect our experience with system repair/replacement design. We have found the estimating data contained in RS Means' Facilities Maintenance and Repair Cost Data to be more representative than their more commonly used new construction cost publications. The data is modified, as necessary, based on our experience with bidding repair and restoration work over a wide geographic area.

RATING CRITERION

In order to better understand each project's importance (in the expenditure forecasts), a rating criterion was established to be able categorize and compare the projects. The goal was to create a rating criterion that was simple, yet effective in relaying important information. The Facility Condition Assessment (FCA) consisted of projects that are assigned various designations (Category, Risk, and Priority) in order to easily sort and compare similar projects.

As a result of the Planning Meetings held with MIT LL key stakeholders during the course of the project, and our knowledge and experience with similar assessments, every project includes a "Category" designation. Categories are defined as:

Category	Description
Life Safety	Work that concerns a life safety issue. These are typically immediate problems that need be addressed and corrected.
Building Code	Work that relates directly to a code issue/violation. These are typically immediate problems that need be addressed and corrected.
Accessibility	Work that can be categorized as repairs, replacements or modifications to a building access to goods and services as it relates to the Americans with Disabilities Act (ADA).
Energy	Work that is identified as potential capital improvements that merit further consideration for energy-saving opportunities.
Environmental	Work that concerns an environmental issue. These are typically immediate problems that need be addressed and corrected.
Aesthetics	Work that concerns the aesthetics of a system or component. This class is typically assigned to repairs or replacements based on the visual appeal of a component's finishes. This class can be assigned to immediate issues, as well as projected expenditures.
Functionality	Work that concerns the intended functionality of a system or component. This class is typically assigned to repairs or replacements that are critical to the function of the building. This class can be assigned to immediate issues, as well as projected expenditures.

Assigning a "Risk" to each project provides a way to describe and categorize potential problems if the work is not completed. The following table lists these six classes, as defined by MIT LL. The risk assigned to each project is the possible negative consequence, if any, that MIT LL would assume if the project was not completed on a timely basis.

Risk
Safety
Environmental
Security
Facility Damage
Operational Impact
None

It is important to assign a class to each work request to help see trends and reoccurring issues that are present for a particular facility group. Identifying projects according to a "Priority" allows highest priority projects to be scheduled and completed first, and provides a method for grouping and scheduling projects that need to be done in future years. The following table lists and describes the five priority classes.

Priority	Description
Priority 1 Currently Critical	Conditions in this category require immediate action to: a. correct a cited safety hazard b. stop accelerated deterioration c. return a facility to operation
Priority 2 Potentially Critical	Conditions in this category, if not corrected expeditiously, will become critical within a year. Situations within this category include: a. intermittent operations b. rapid deterioration c. potential life safety hazards
Priority 3 Necessary (Not yet critical)	Conditions in this category require appropriate attention to preclude predictable deterioration or potential downtime and the associated damage or higher costs if deferred further.
Priority 4 Recommended	Conditions in this category include items that represent a sensible improvement to existing conditions. These are not required for the most basic function of the facility; however, Priority 4 projects will improve overall usability and/or reduce long-term maintenance costs.
Priority 5 Does Not Meet Current Codes/Standards; "Grandfathered"	Conditions in this category include items that do not conform to existing codes, but are "grandfathered" in their condition. No action is required at this time, but should substantial work be undertaken in contiguous areas, certain existing conditions may require correction.

The priority provides a general time frame of when projects need to be performed. It is important to prioritize projects to help show their urgency and to plan for the projects that will need to take place years in the future. This method of prioritizing will allow projects to be grouped together over a certain span of years so they can be budgeted at the appropriate times.

Methods of categorization can help a facility manager differentiate between facilities that have immediate needs, that are going to need attention in the near future, or that have relatively less need. By

implementing this process of categorization for replacement, renovation and maintenance of all infrastructure assets, it is more likely to have projects completed on time and within budget. It will also promote improved stewardship of assets as facility needs are planned and addressed in a proactive manner rather than in a reactive manner or in response to a crisis.

PRELIMINARY ENERGY AUDIT SUMMARY

We performed a preliminary energy audit at the MIT LL buildings in general accordance with the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) "Procedures for Commercial Building Energy Audits", 'Level 1 – Walk-Through Analysis'. Our Level I Analysis provided a preliminary energy audit that identified low-cost and no-cost measures and provided a list of potential capital improvements that merit further consideration.

Each individual building includes a preliminary energy audit report at the end of the condition assessment report.

Following is a summary of campus-wide energy-saving opportunities at the MIT LL campus:

Low-Cost and No-Cost Operation and Maintenance (O & M) Measures

HVAC Controls

1. Utilizing the existing Andover Controls energy management system, incorporate the following control strategies:
   - Optimized start of all air-handling units, fan-coil units, and other HVAC equipment which is scheduled off during unoccupied hours.
   - Stagger equipment and lighting on gradually in approximately 15-minute increments at buildings on the same electrical demand meter.
   - Program outside dampers to be closed during early morning start-up, unless used for 'free cooling' economizer cycle.
   - Program off building toilet exhaust fans and general building make-up air fans after building is unoccupied and/or when all air-handling equipment is scheduled off.
2. Calibrate supply and return water temperature sensors and differential pressure controls at each building to ensure accurate data for use in making decisions to efficiently operate the chilled water plant.
3. Implement an extensive steam trap maintenance program, which includes a computerized inventory of all steam traps noting location, type, size, date installed or rebuilt, date last inspected, and a listing of faulty traps with target dates for replacement or rebuild. Inspect each steam trap at least annually using an ultrasonic or other device. Consider installing orifice-type steam traps where applicable, since these traps fail closed (resulting in eliminating waste and providing a sign that the trap is faulty), require minimal maintenance, and have a longer service life.

Capital Improvements

HVAC Controls

1. Gather data from the existing Square D power management system (490 metering points), select equipment monitored and controlled by the campus-wide Andover Controls system (approximately 300 points), and all Delta-V system equipment (approximately 200 points). Sharing data between systems would provide opportunities for improved overall system efficiency and performance. Create a gateway for this information to be used by the Andover Controls system to optimize automation of building systems. For example, power data could be used to better control electrical demand. Also, provide select data such as instantaneous temperature and differential pressure readings at each building for use by the Delta-V control system at the central plant in optimizing plant efficiency. Utilize existing fiber optics cabling to each building for control of 2-way valves, which are currently adjusted regularly by the plant operators from a separate interface based on ever-changing differential pressure setpoints.

2. As budget allows, replace pneumatic controls, including all 2-way differential pressure control valves at each building, with digital controls.
3. Add 2-way control valves at all 'wild coils' where there is no control valve. Where feasible, convert a majority of 3-way control valves at buildings to 2-way valves. This provides enhanced energy savings from utilization of VFD controls at chilled water pumps.
4. Install variable frequency drives (VFDs) on fan motors 5 HP and larger. Utilize PWM drives where power factor correction is desirable.
5. Based on the large volume of conditioned air exhausted from many of the buildings to meet ventilation requirements of the laboratory areas, it is recommended that laboratory hood exhaust fan and make-up air systems be turned off or set back automatically when not in use (and not required for 24/7 operation). We understand that the current policy is to keep these hoods operating continuously. System modifications should be evaluated that would reduce energy use from hoods by slowing down exhaust, minimizing conditioned make-up air supplied, etc. when the hoods do not require full operation. Options include Phoenix Controls 'usage based controls' utilizing a sensor to detect the presence of an operator and a sash position sensor. Controls can provide variable air volume or two flow states (i.e. operation at 100 feet per minute occupied or 60 feet per minute unoccupied). Use of a bypass damper at the roof exhaust duct would reduce conditioning make-up air requirements during unoccupied periods, but no savings would result in the exhaust system. Consideration should be given to installing heat recovery systems where feasible in conjunction with system upgrade or replacement.

<u>Equipment</u>

6. Purchase only premium-efficiency motors upon replacement. Consider the energy cost savings resulting from replacing a motor before deciding to rewind the motor.
7. Evaluate the cost/benefit of installing energy recovery units where exhaust air and make-up air quantities are large and the two systems are in close proximity to one another. Examples may include at lab hoods and general building exhaust and make-up air applications.

<u>Lighting</u>

8. Retrofit all remaining fluorescent T12 lamps and magnetic ballasts with energy-saving T8 or T5 lamps and electronic ballasts throughout campus. (Note: Buildings A, B, C, and D completed). Utilize programmed start ballasts in applications where occupancy sensors are to be employed. The payback for this retrofit ranges typically from 1.5 to 2.5 years, depending upon use hours. Retrofits involving only lamp and ballast replacement are generally most economical using T8 lamps, since these lamps are approximately 2 to 3.5 times less costly than T5 lamps. 'Re-fixturing' involves converting the fixture also to utilize T5 lamps which are shorter and have a different bi-pin arrangement. The cost for 're-fixturing' ranges between $60 and $80 per fixture, and may not always result in a system with improved lumens per watt. The largest benefit of T5 technology over T8 is slightly higher lumens per watt when used in a fixture designed for T5 lamps. The T5 lamps are typically brighter and therefore can cause glare on computer screens.
9. Replace incandescent lamps/fixtures with energy-efficient retrofits such as compact fluorescents. The payback for these retrofits is usually within 1 to 1.5 years.
10. Install occupancy sensor lighting controls throughout the campus at individual office areas, conference rooms, restrooms, large storage areas, copy rooms, laboratories, and select corridors. The payback for these controls ranges typically from 1 to 2.5 years, depending upon the installation cost potential 'off' hours, and wattage of fixtures controlled.
11. Install daylighting controls in areas/rooms where adequate daylight is available and lights are left on. (Note: dimmable fluorescent ballasts are required). New controls are on the market which perform both shut-off using occupancy sensing and dimming using a photocell, combined into a single unit.

Electrical

12. The power factor for some electrical services at the campus is reportedly approximately 0.8 to 0.85. Install approximately 400 to 500 kVA power factor correction capacitor banks for older buildings (load approximately 1,500 kW):
    - 4,160-volt service at substation section serving Buildings A, B, D, and Parking Garage
    - 4,160-volt service at substation section serving Buildings C, E, and F
13. Identify equipment at each building that can be shed both automatically and manually in the event of a call to reduce demand under the new demand response program.

Electric Rates

Current average electric rates provided and used in our estimate of savings were as follows:

- Energy Charge Only (Constellation New Energy) = $0.09234/kWh
- Distribution Cost (NSTAR) = $0.04760/kWh
- Combined Energy Charge and Distribution Cost = $0.140/kWh

Current electrical demand charges reported were reportedly approximately $25/kW 'on-peak' (June through September) and $13.86/kW 'off-peak' (October through May).

Improving the Way You Manage Facilities

Facility Engineering Associates, P.C.
1601 Trapelo Road, Suite 182
Waltham, Massachusetts 02451
(781) 890-2254
www.feapc.com

APPENDIX D: FUNCTION ASSESSMENT

MIT LINCOLN LABORATORY

Existing Building Functional Analysis
Conceptual Site Master Plan Study
FINAL DRAFT | August 3, 2010

P A Y E T T E

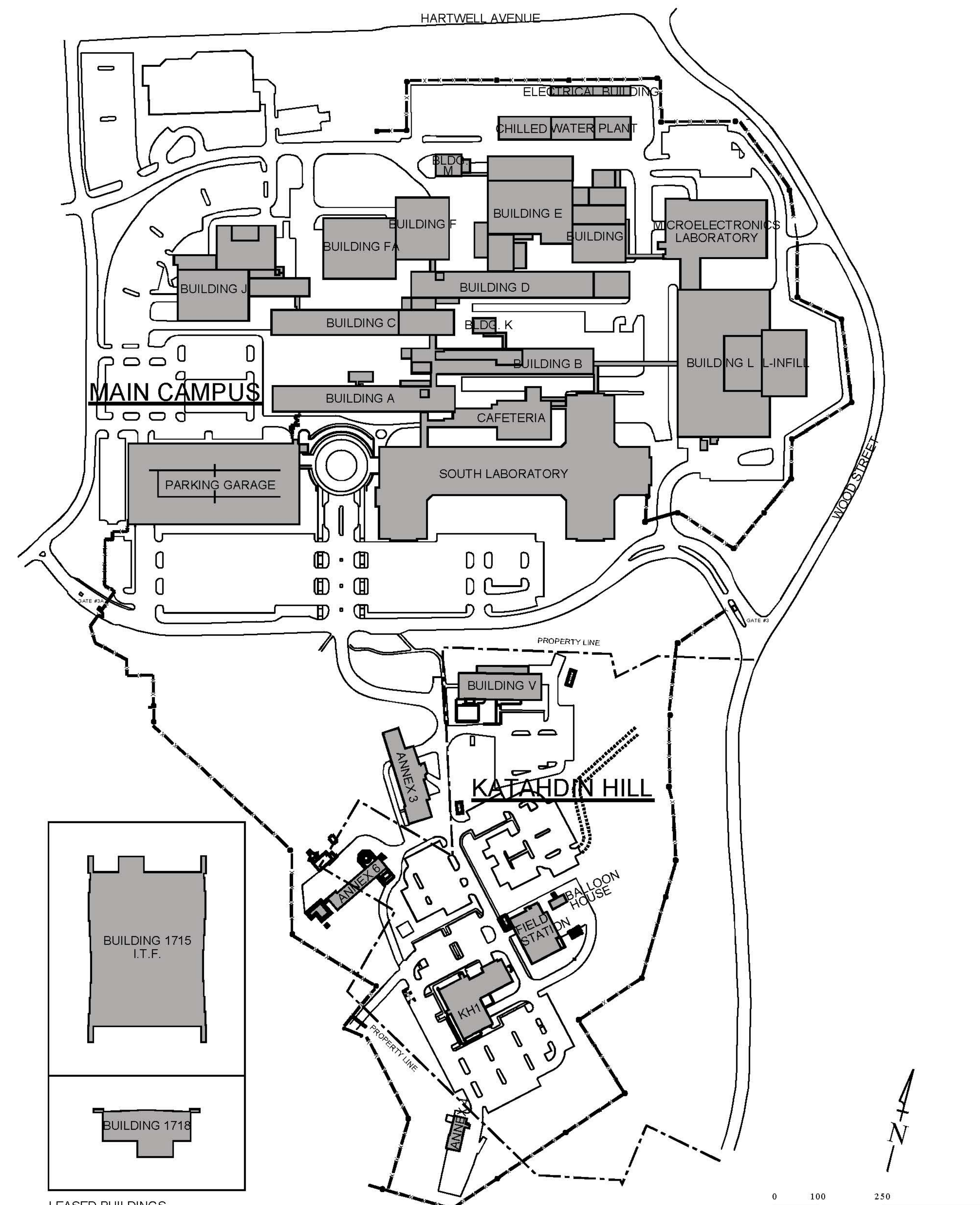
Narrative: Goals/Objectives, Process.
The objective of the analysis and evaluation of MIT Lincoln Laboratory's existing buildings is to determine how well they meet the functional requirements of the current operations and what is the highest-and-best-use program fit for future utilization. This phase of the study was conducted from February 11, 2009 through March 30, 2009 and was comprised of the following steps:

- A walk-through of typical space types in each Division (except as noted).
- A brief discussion/meeting with representatives from the each Division prior to the tour.
- A review of FEA's Facility Condition Assessment report, dated October 27, 2008.
- A review of the floor plans for each building.
- An evaluation of how well each building supports the various functions of "Office," "Laboratory," "Special Purpose," and "Building Support" (see below for further detail).
- A summary analysis and recommendations.

The outcome of this phase of the Conceptual Site Master Plan Options analysis and evaluation is Payette's recommendation that almost half the Main Lincoln Laboratory Campus buildings have outlived their functional capabilities. Payette recommends these structures be vacated and/or demolished as part of a campus redevelopment plan to be defined in the subsequent phases of the study.

Assumptions.
Analysis and evaluation of the existing buildings is based on the following assumptions:

- The spaces toured are representative of the space types and program uses typical to MIT Lincoln Laboratory.
- Since no walk-through of Division 10 spaces was performed (ISR Systems & Technology), we assume the spaces are similar to representative spaces of other Divisions.
- Since no walk-through of Building J was performed, we assume the spaces are similar to other office-type "closed" spaces.
- This evaluation is based on a general review of existing conditions, functions, and building floor plans.



Criteria.
Five categories of evaluation criteria were developed to assess how well each building in its current state supports or could support the different functional components at MIT Lincoln Laboratory. The criteria for this process are based on architecture and structural design (physical and dimensional characteristics). Please reference FEA's Condition Assessment Report for a related evaluation of building systems, including mechanical, electrical, plumbing, etc. The adjacent table describes the categories and their relative assessment scale.

Building structural load capacity (lbs/sf) and vibration design criteria were not available. While these are important criteria to evaluate functional use of the buildings in relation to certain programs, they are not part of the evaluation at this time. When this information becomes available, analysis can be completed for each of the buildings and space types.

Functional Evaluation Criteria

Bay Size	The distance between column center lines across the length of a building.	
	A structural bay size of 22' to 24'.	Supports intensive lab bench/equipment functions such as 36" deep benches and equipment with front & rear cable connections Supports office environment with enclosed and open office functions
	A structural bay size of 20' to 22'.	Supports minimal to moderate lab bench/equipment functions Supports office environment with enclosed and open office functions
	A structural bay size of less than 20' or more than 24'.	Not appropriate for lab bench/equipment functions. Provides for less than optimal support for enclosed single office functions

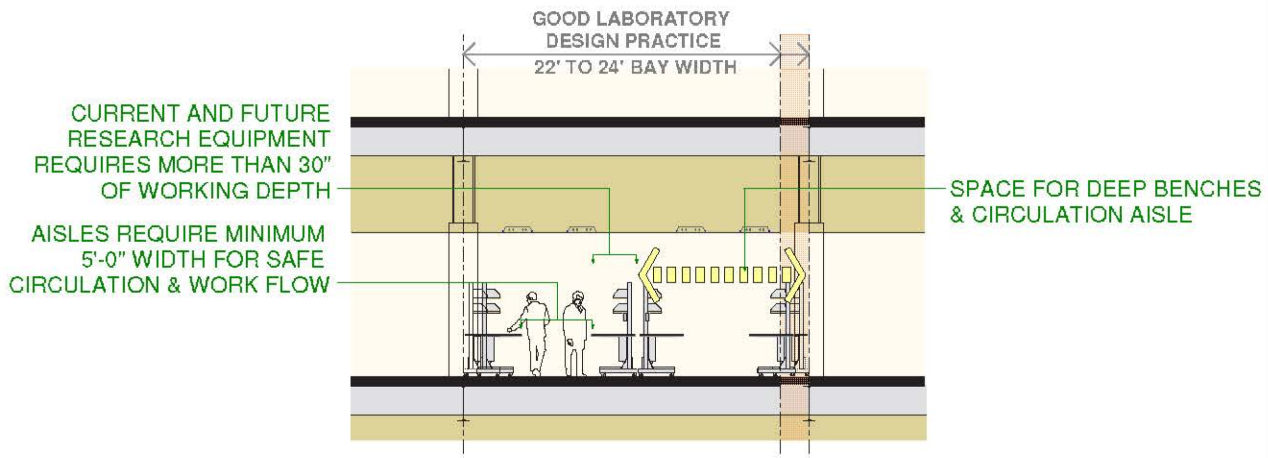
Zone Depth	The width of contiguous space spanning between the exterior wall and corridor wall or the opposite exterior wall or between two parallel corridor walls.	
	A zone depth of 45' to 55'	Supports "laminated" zones of functions such laboratory and support rooms and/or office. Supports large floor space fuctions. Provides best adjacency of function.
	A zone depth of 30' to 45'	Supports "laminated" zones of functions such laboratory and support rooms (or office). Provides good adjacency of function.
	A zone depth of less than 25'	Less than optimal for laboratory functions

Floor-to-Floor	The vertical dimension between the top of the finished floor slabs of two consecutive building levels	
	A floor-to-floor dimension of 18' or greater	Supports all laboratory and non-lab functions. May allow for interstitial service level
	A floor-to-floor dimension of 14' to 18'	Supports most laboratory and all non-lab functions.
	A floor-to-floor dimension of less than 14'	Supports some "dry" laboratory and all non-lab functions

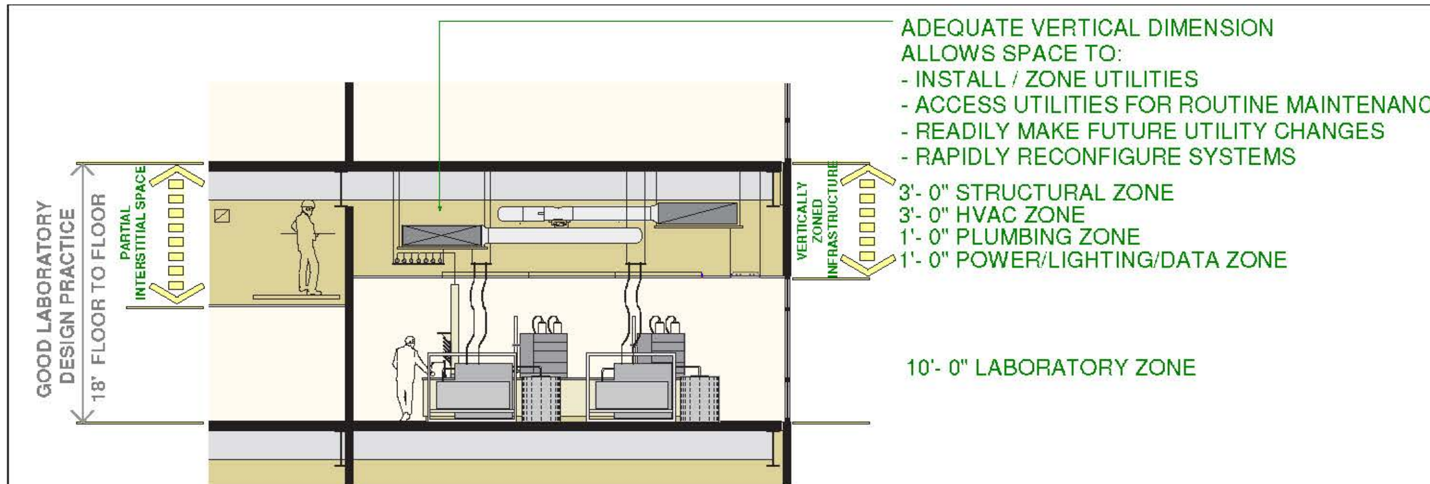
Load Capacity	The design live load (the variable weight of people, equipment, furniture, etc.) capacity of the floor slab stated in pounds per square foot	
	A live load capacity of 250 lbs/sf or more	Supports all laboratory and non laboratory functions
	A live load capacity of 100 to 250 lbs/sf	Supports most laboratory and all non laboratory functions
	A live load capacity of less than 100lbs/sf	Supports office type functions

Vibration	The transient or steady state oscillation of the floor slab measured in micro-inches per second	
	A floor vibration of 500 micro-inches/sec or less	Supports most vibration sensitive laboratory activities
	A floor vibration of 1,000 to 4,000 micro-inches/sec	Supports standard wet laboratory and electronics laboratory activities
	A floor vibration greater than 4,000 micro-inches/sec	Supports standard office activities

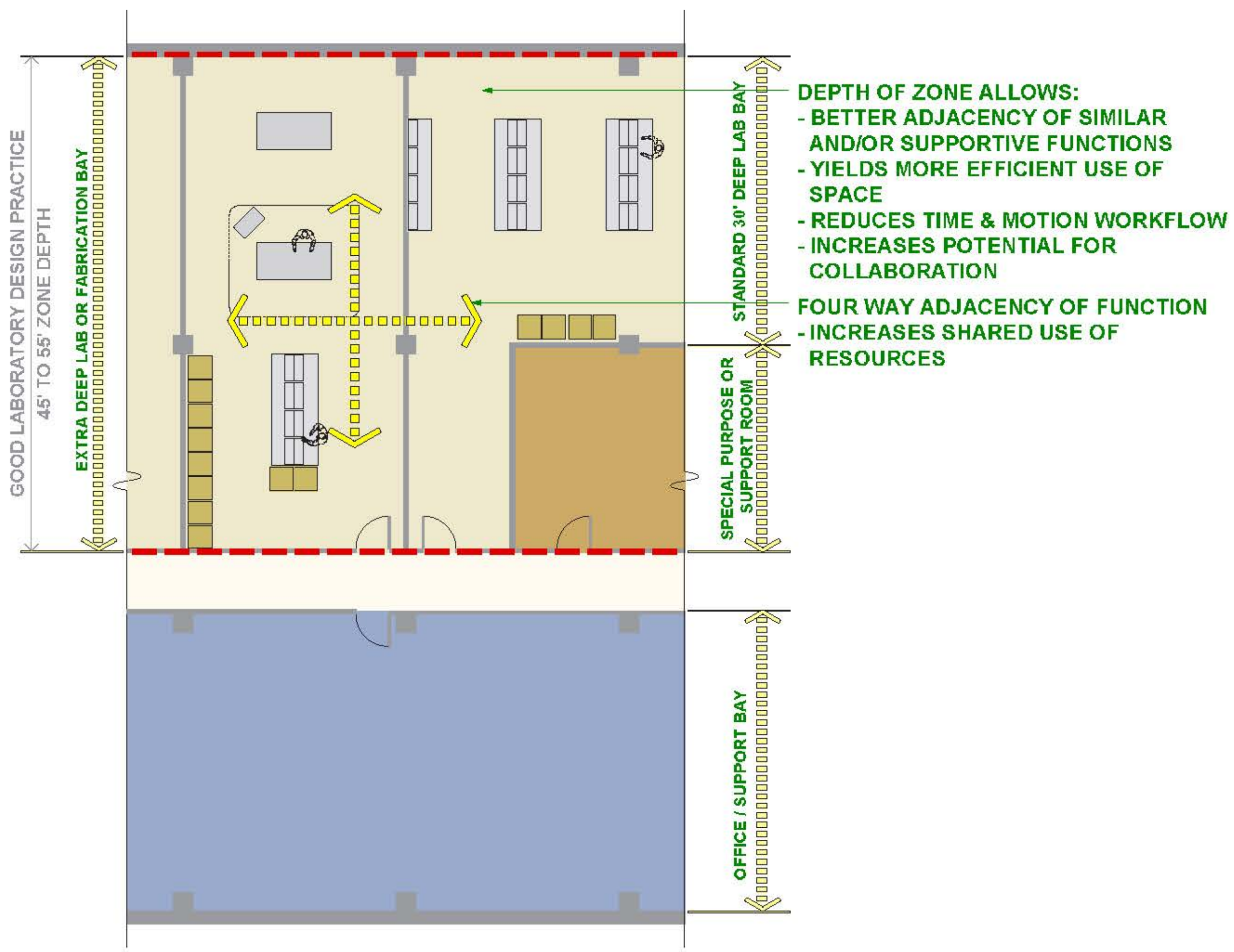
Best Practice



Bay Size



Floor-to-Floor Height



Zone Depth

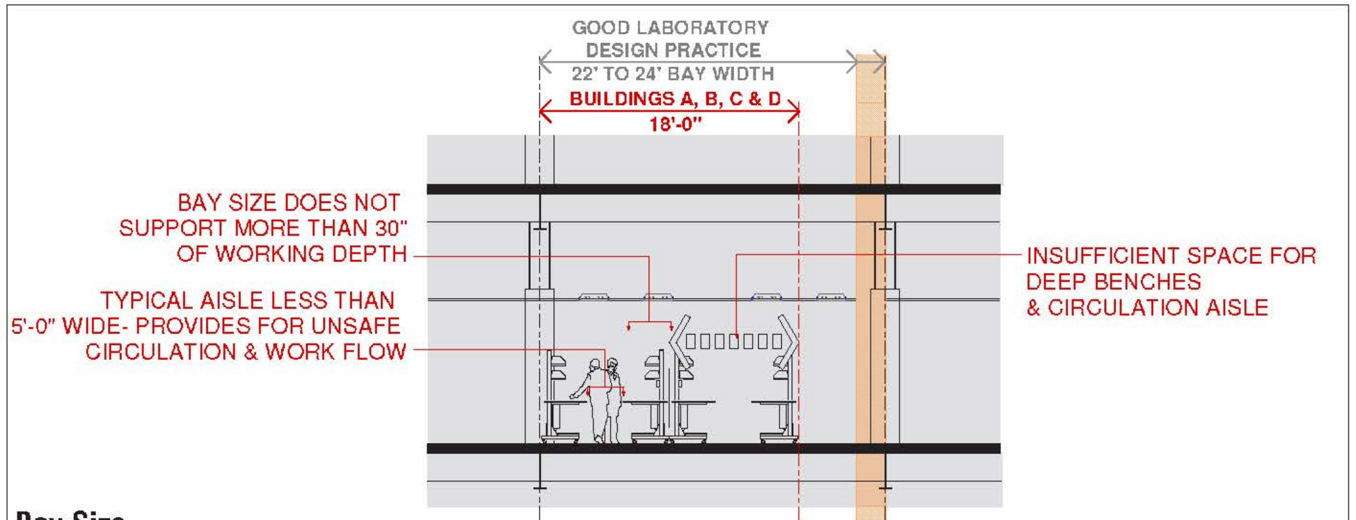
Analysis.

Best practice for laboratory use is illustrated by the three key criteria on this page: bay size, floor-to-floor height, and zone depth. The dimensions provide for optimal spatial and programmatic relationships, as well as utilities and infrastructure required for a state-of-the-art laboratory. Buildings that fall within these criteria have flexibility to accommodate a range of uses, infrastructure and equipment that are required by the type of science being performed at MIT Lincoln Laboratory.

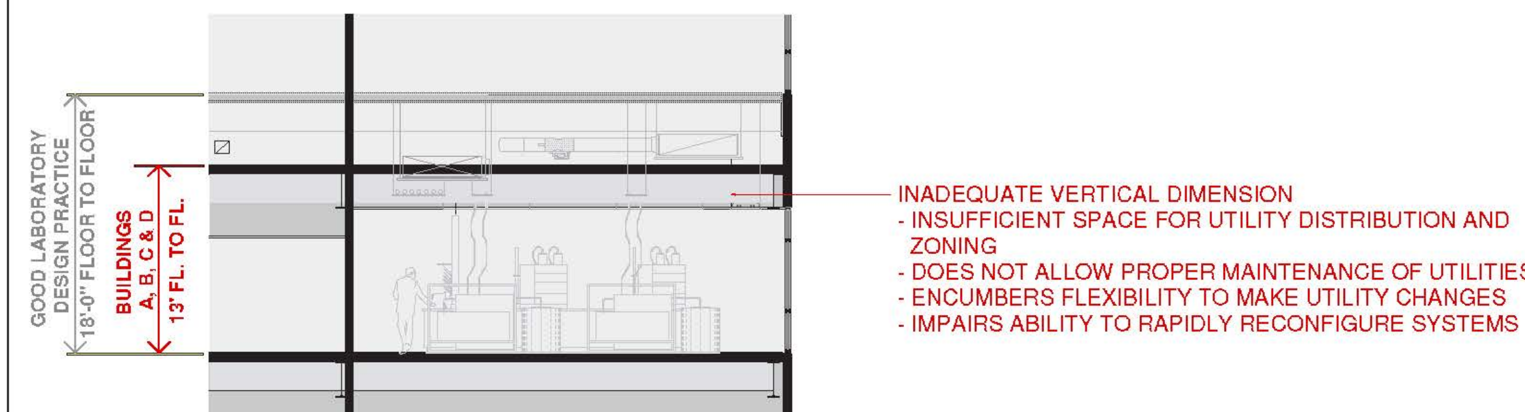
How well do the existing buildings measure up to the functional evaluation criteria? Diagrams on the following pages illustrate how each existing building on the MIT Lincoln Laboratory Main Campus compares to the state-of-the-art criteria. While some buildings fall within the best practice criteria in one or more categories, none of the buildings meet all of the criteria described in the best practice diagrams. It is important to understand how an existing building performs in general, because if even one or more criteria are not met, laboratories may not be the highest and best use for that building.

Additionally, several buildings, most notable Building J and Buildings E and I have been renovated and added to over time. While parts of the building may meet the criteria for labs, renovating those buildings would be challenging given the different structural zones and conditions of varying sizes and configurations.

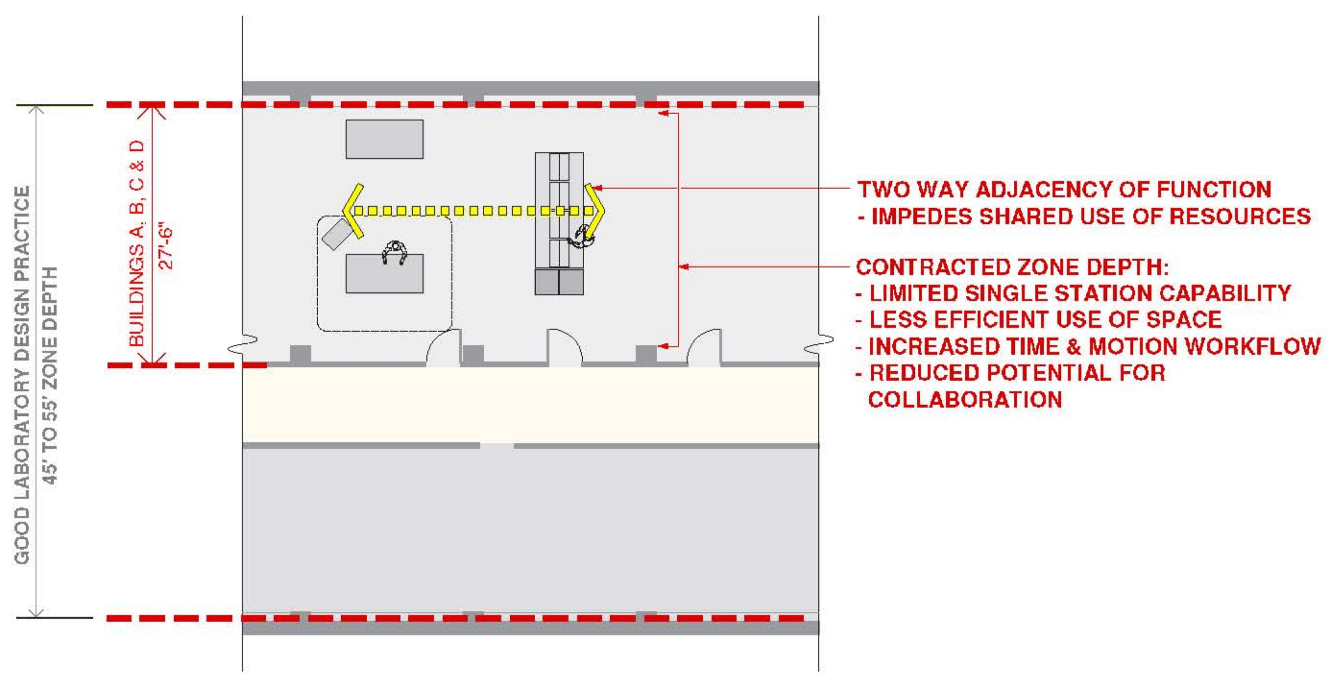
Existing Conditions: Buildings A, B, C, D



Bay Size



Floor-to-Floor Height



Zone Depth

Diagram Key.
The diagrams on this page compare to the conditions of Buildings A, B, C, and D with best practice.

Bay Size: The existing bay width (center-lines, with corresponding illustration of bench spacing) is superimposed on the "Best Practice" diagram.

Floor-to-Floor Height: The existing building floor-to-floor height is superimposed on the "Best Practice" diagram.

Zone Depth: A representative partial plan zone is illustrated with a comparison to the "Best Practice" zone depth.

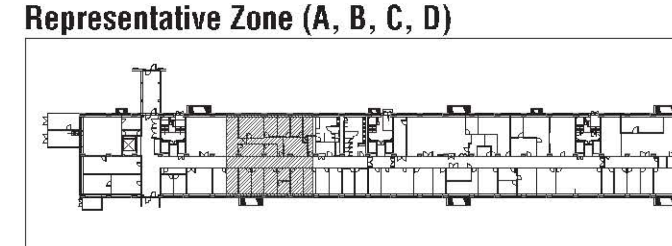
Diagram Annotation Color: Text color is used as a graphic indicator of the relative merit of the existing condition compared to the "Best Practice".

Green text: Existing condition meets or exceeds the "Best Practice" criteria.

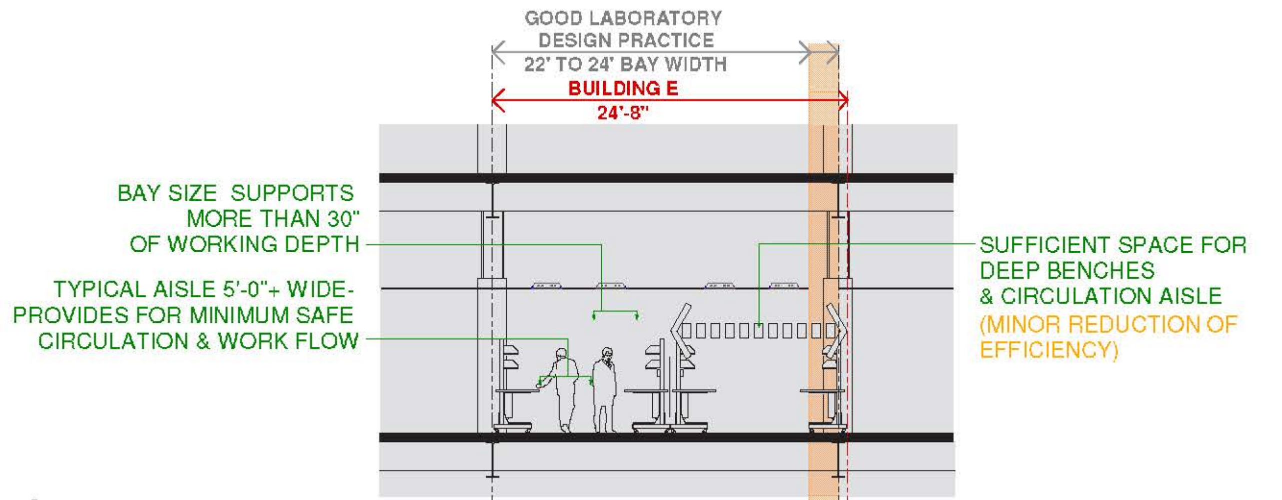
Yellow text: Existing condition is slightly below or outside of the "Best Practice" criteria.

Red text: Existing condition compares poorly to the "Best Practice" criteria.

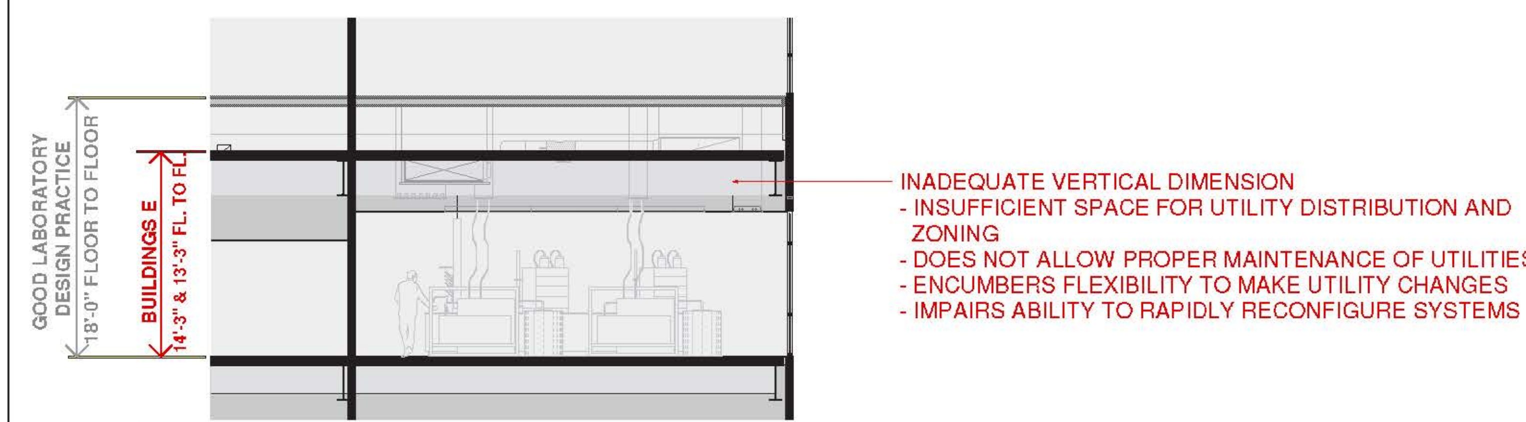
Representative Zone (A, B, C, D)



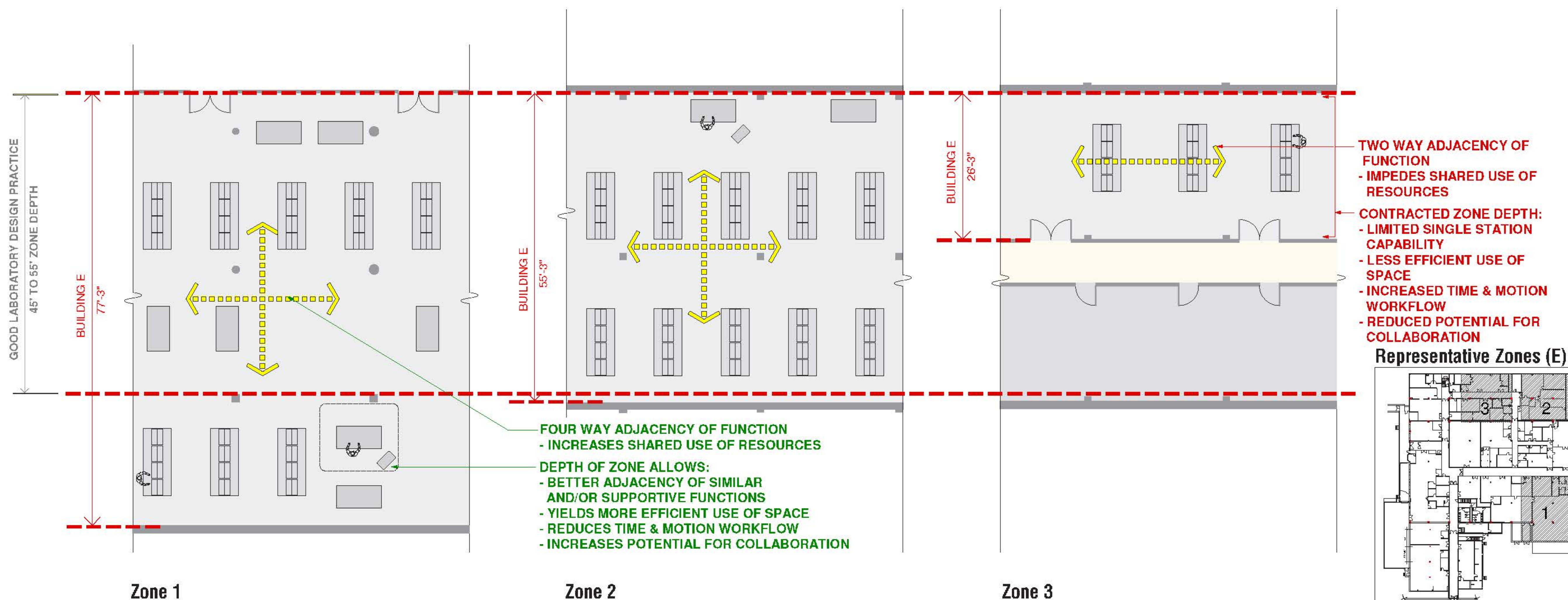
Existing Conditions: Building E



Bay Size

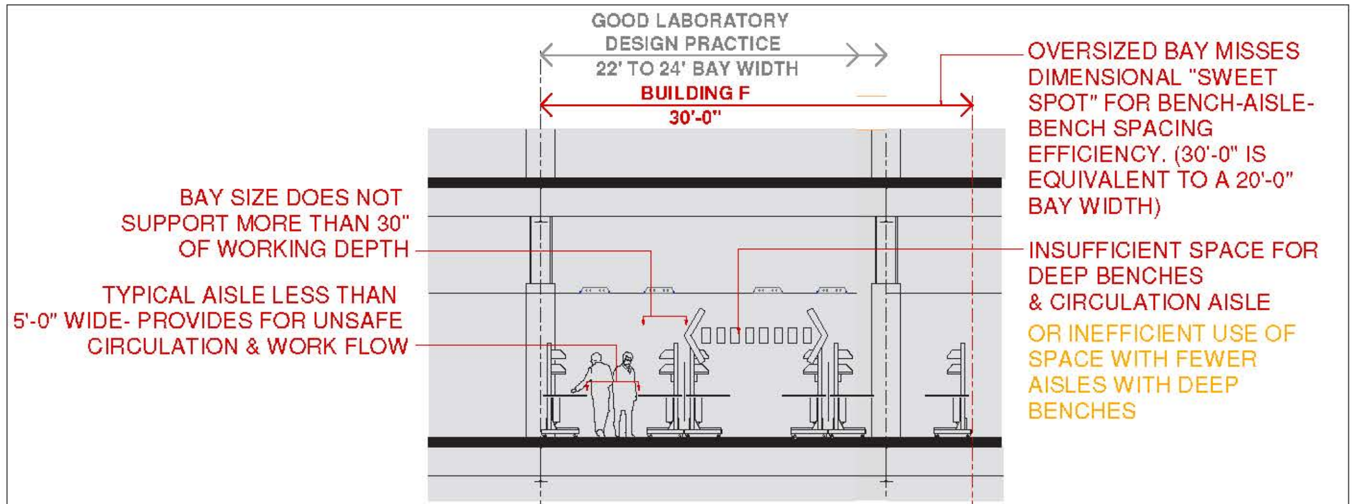


Floor-to-Floor Height

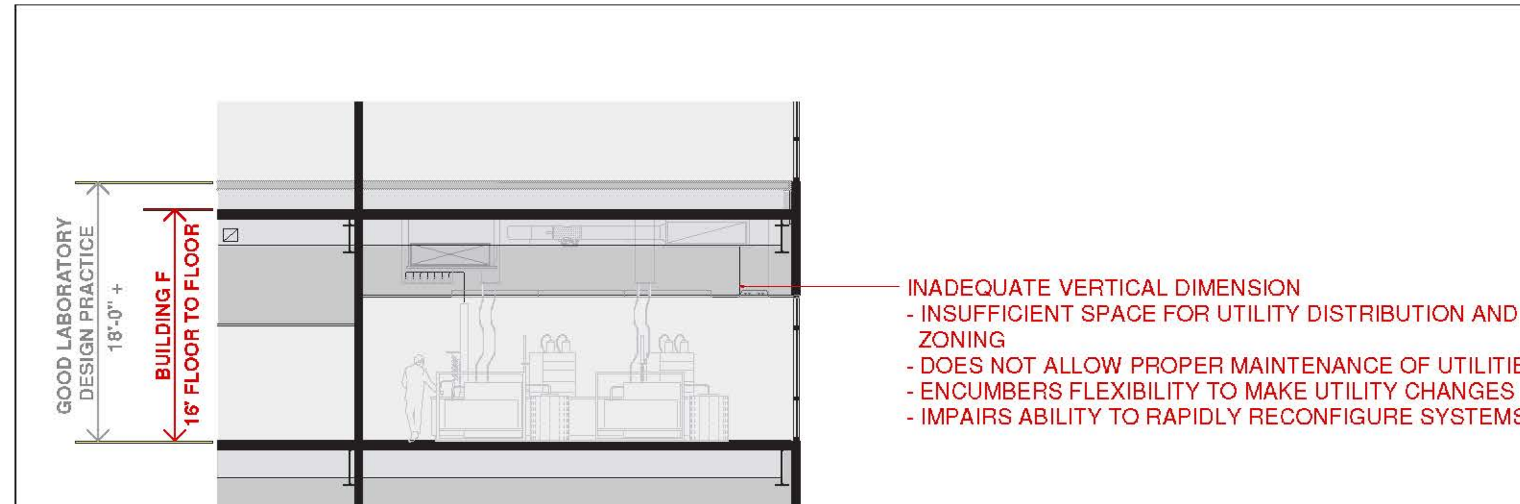


Zone Depth

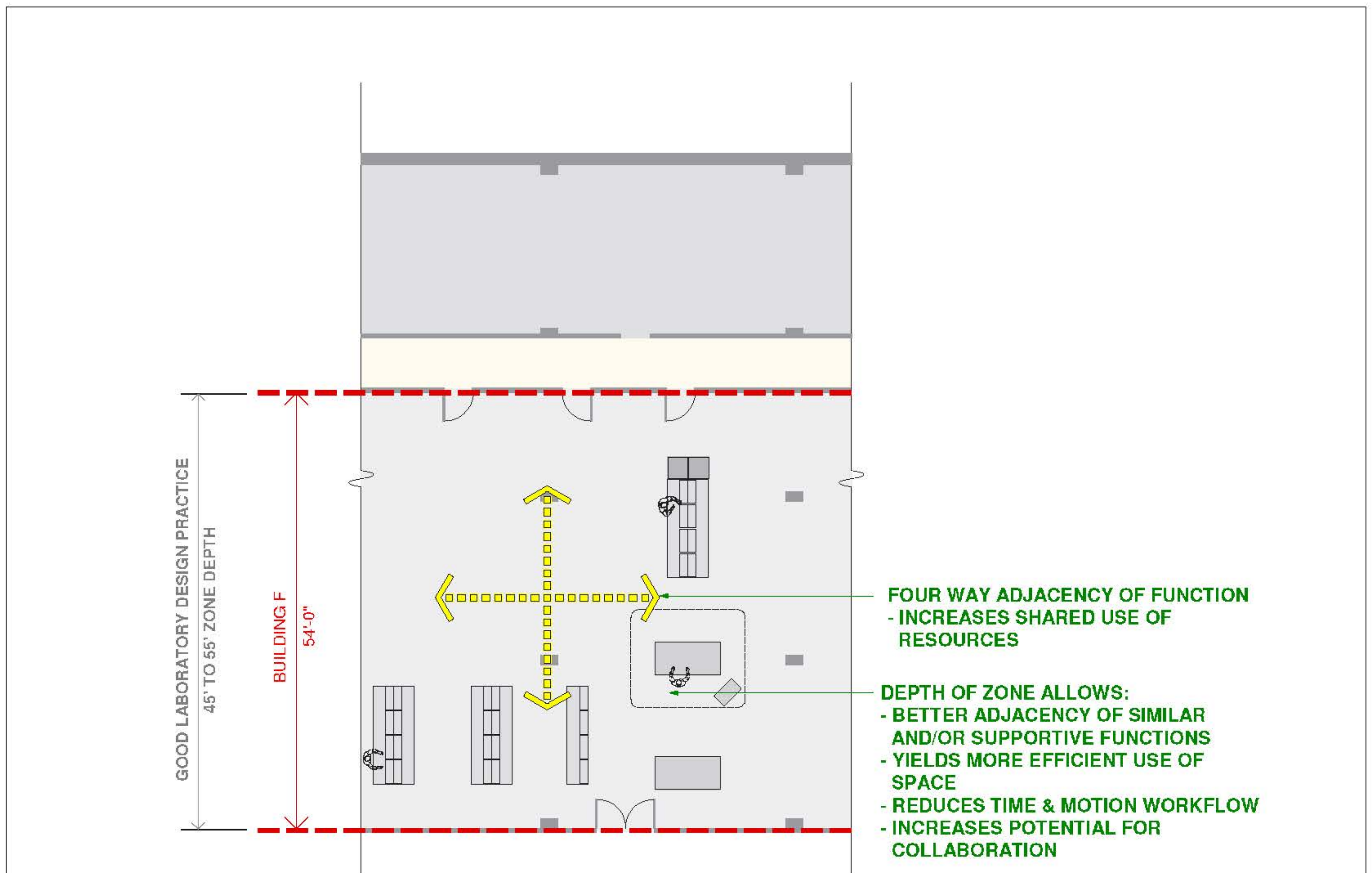
Existing Conditions: Building F



Bay Size

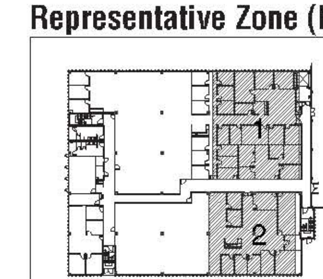


Floor-to-Floor Height

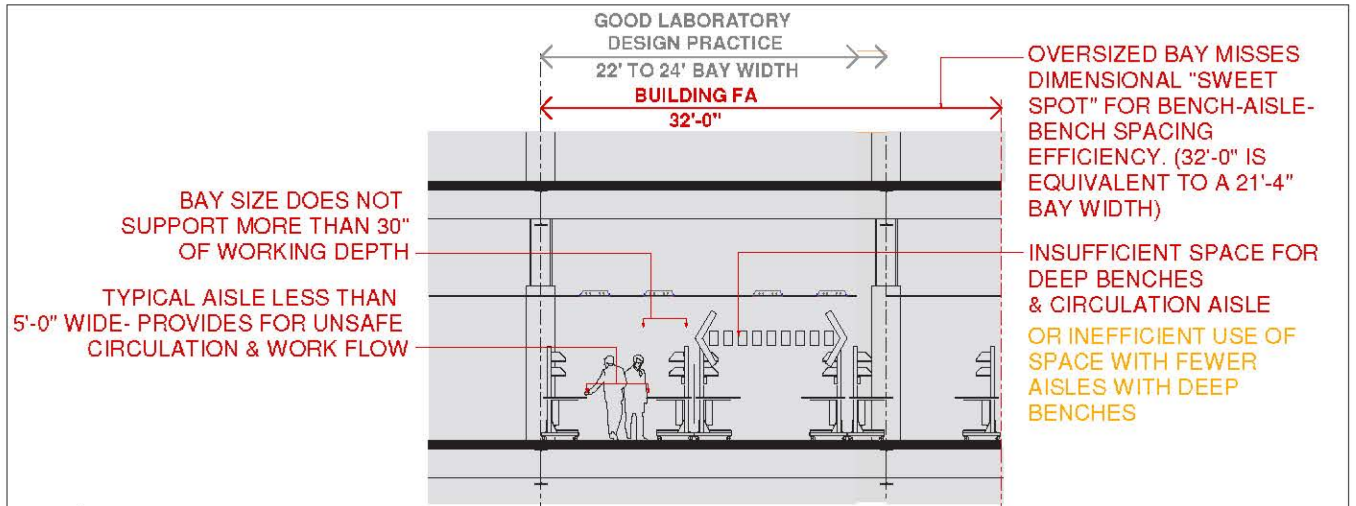


Zone Depth

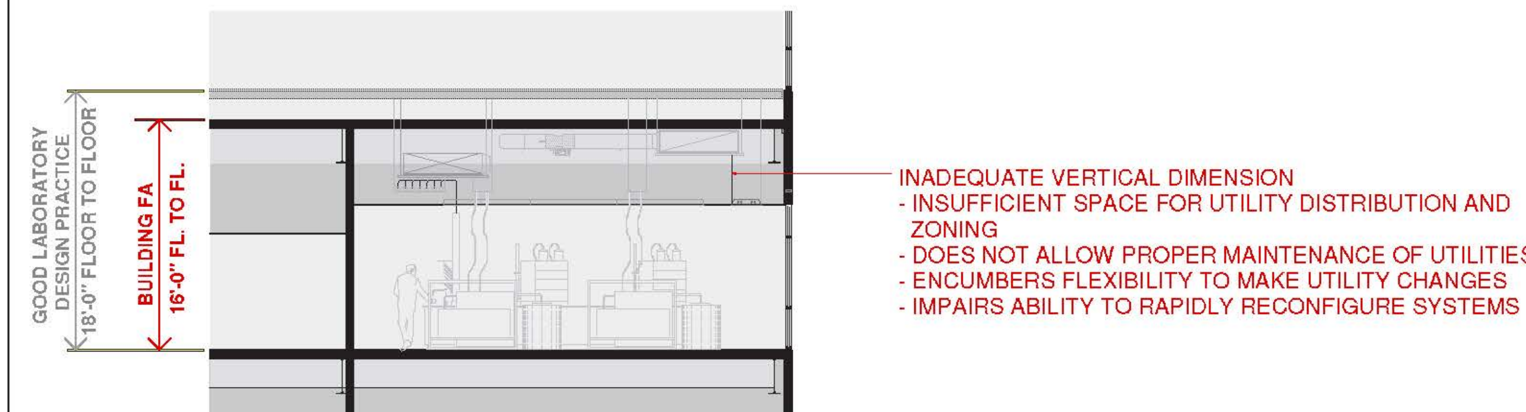
Representative Zone (F)



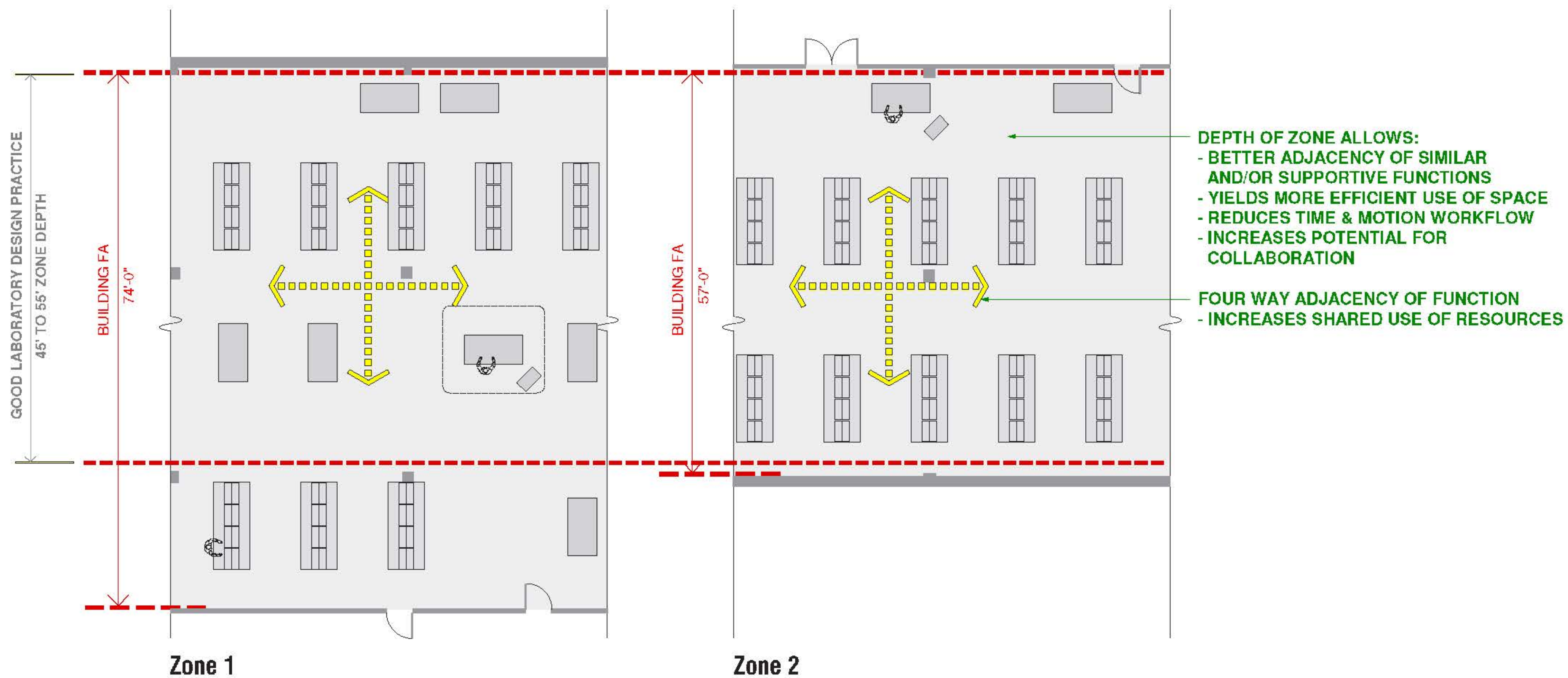
Existing Conditions: Building FA



Bay Size

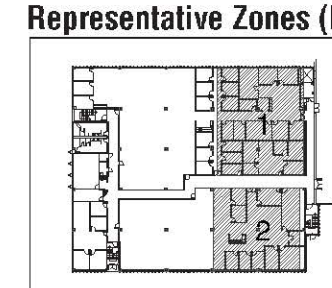


Floor-to-Floor Height

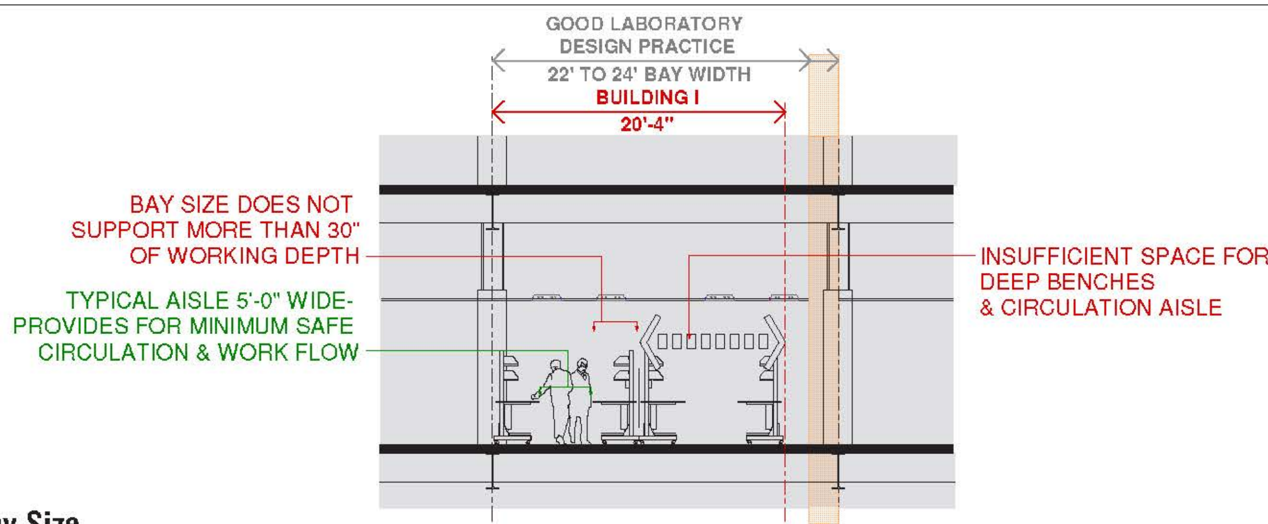


Zone Depth

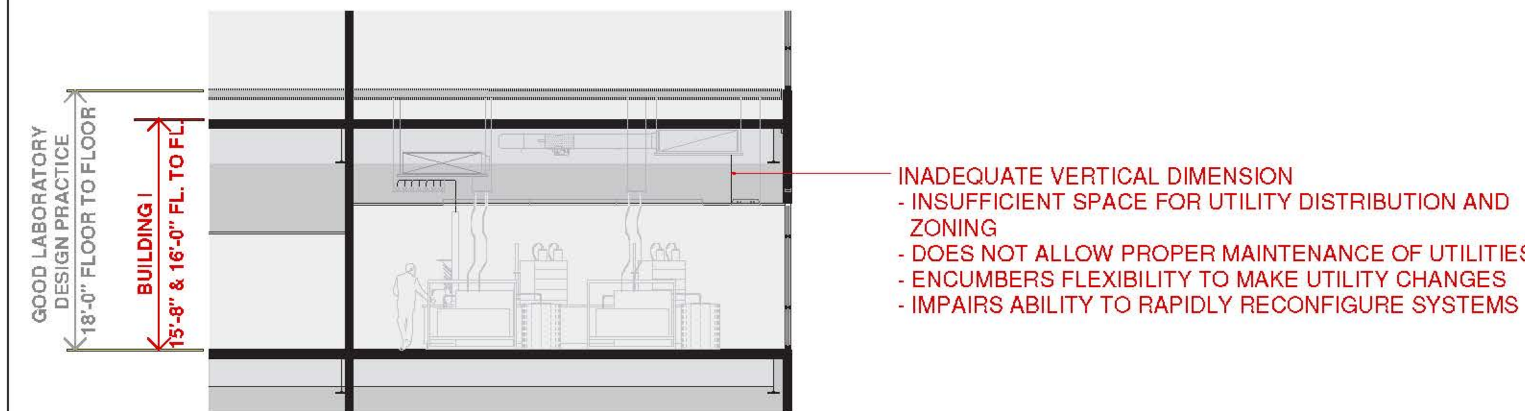
Representative Zones (FA)



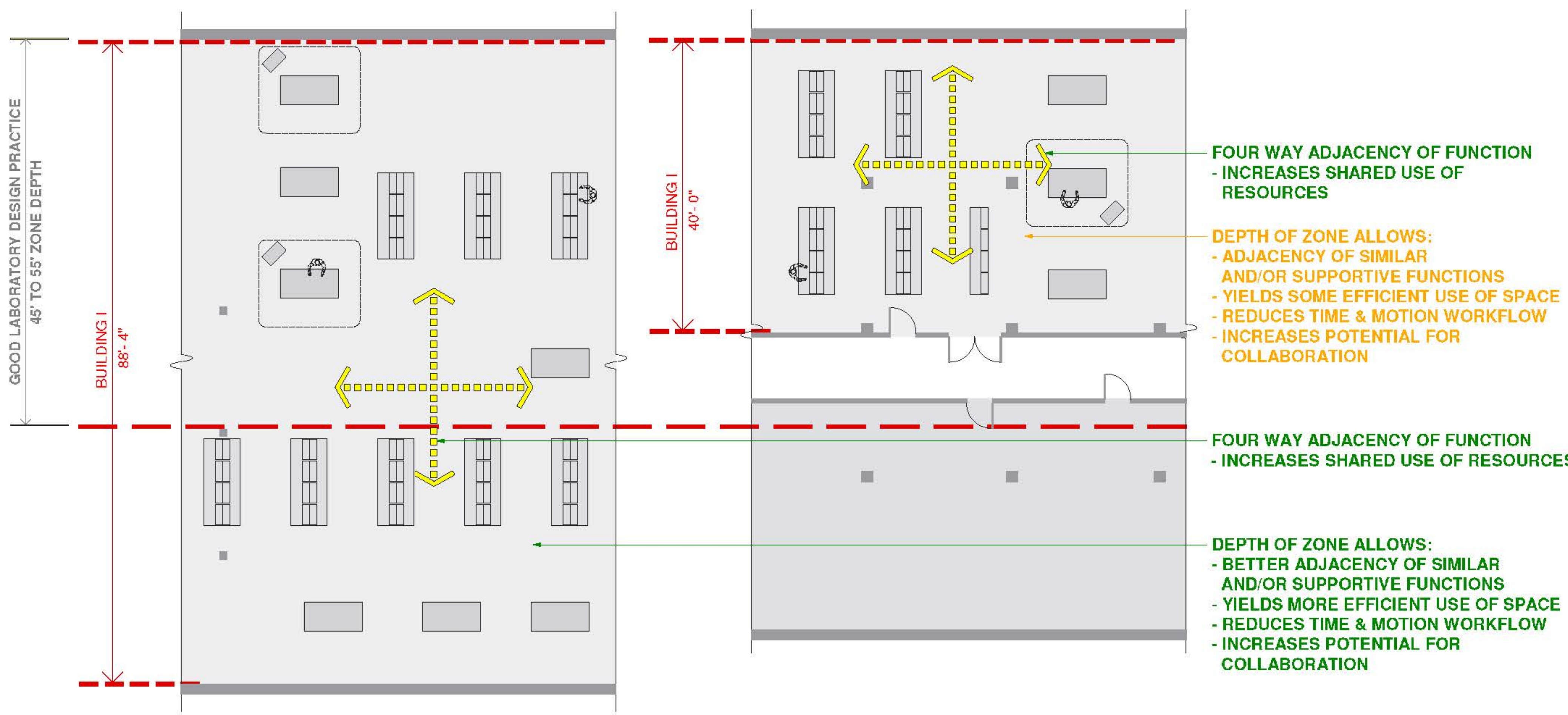
Existing Conditions: Building I



Bay Size



Floor-to-Floor Height

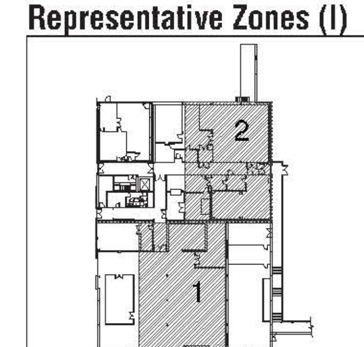


Zone Depth

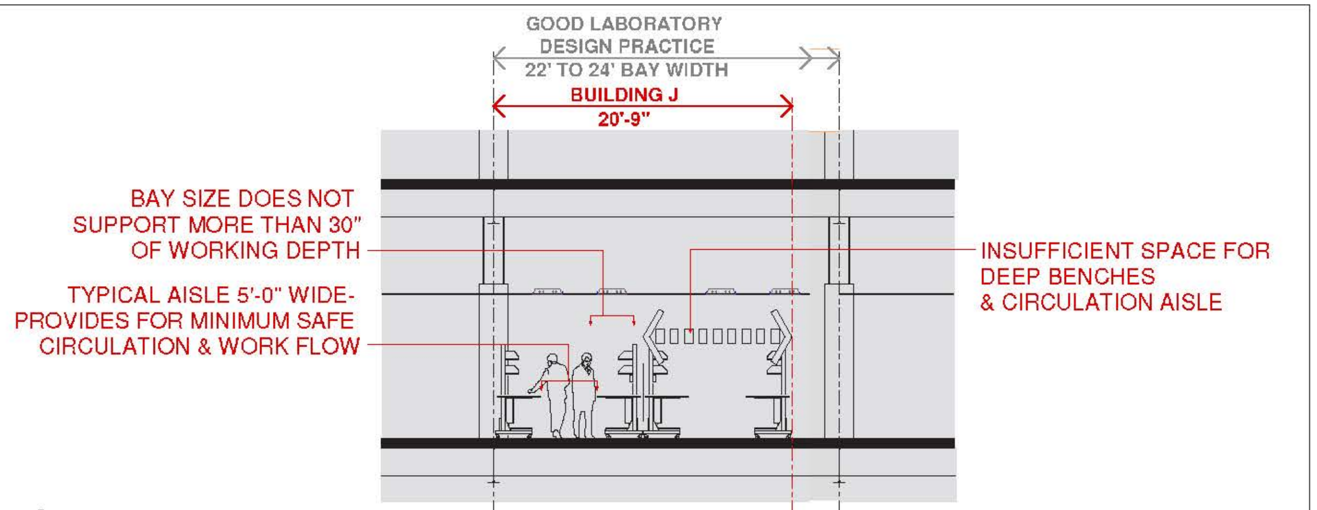
Zone 1

Zone 2

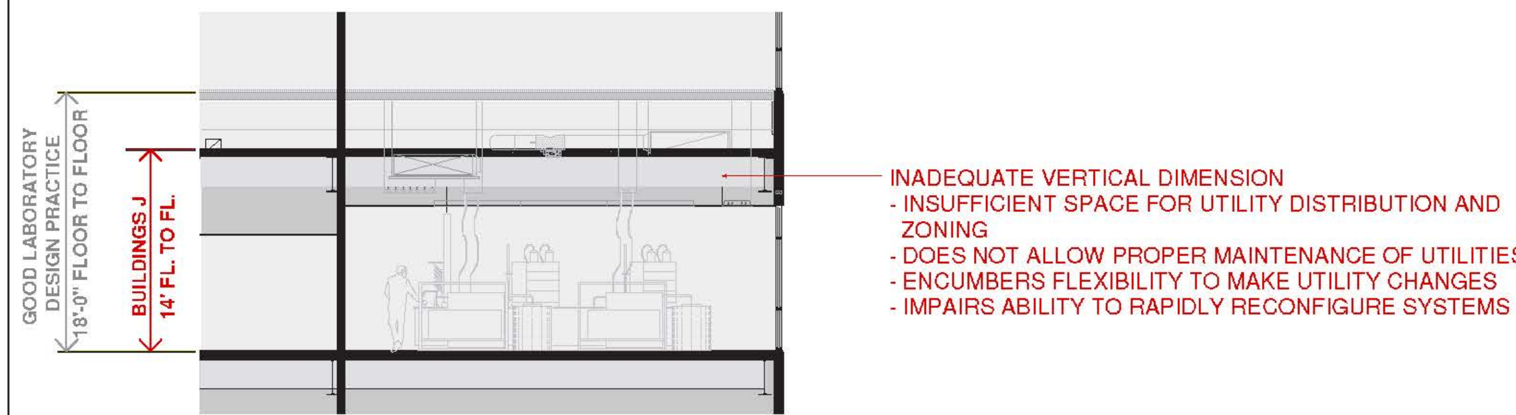
Representative Zones (I)



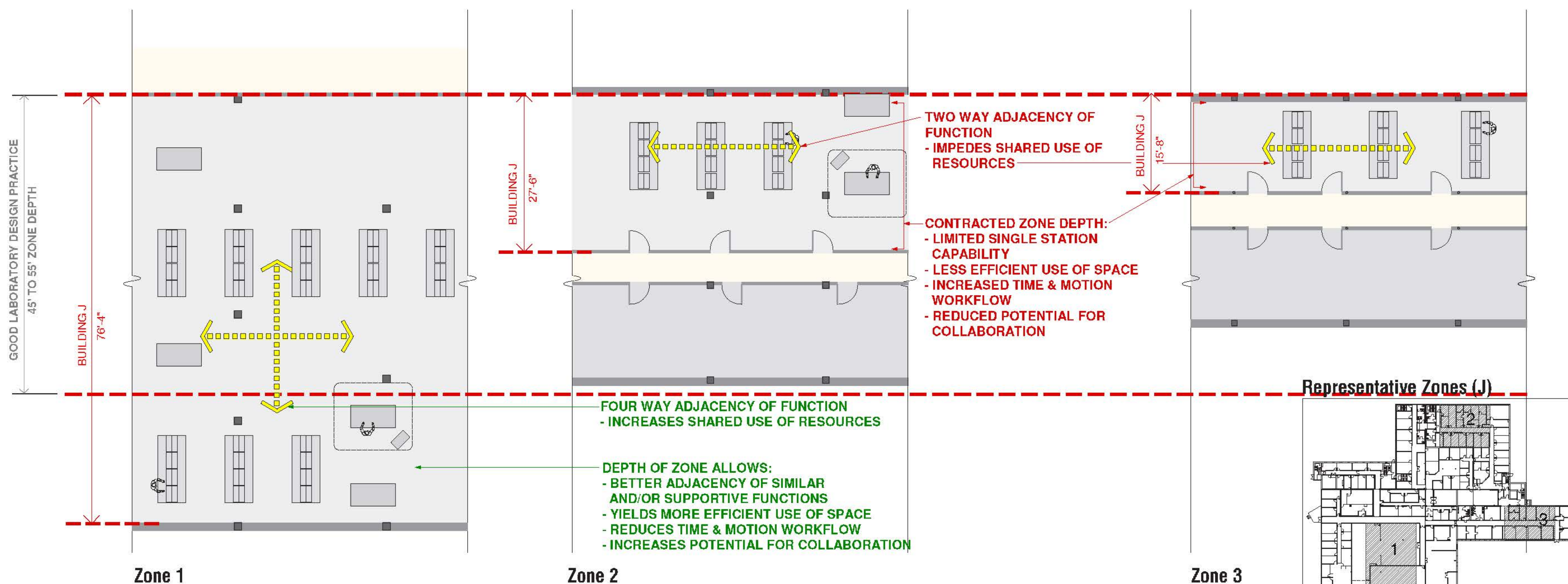
Existing Conditions: Building J



Bay Size

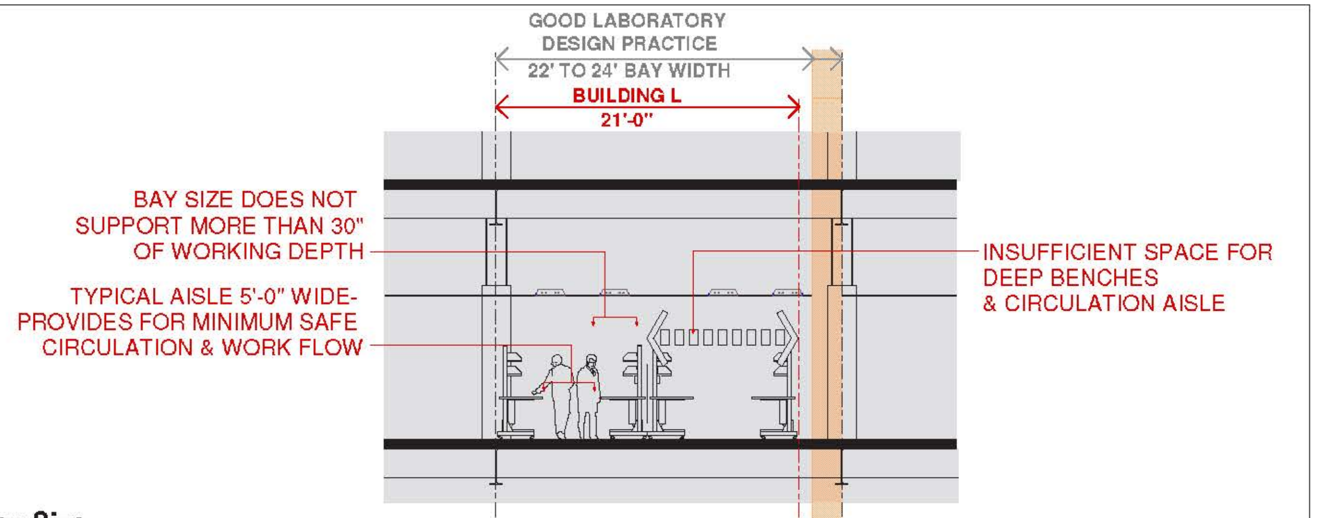


Floor-to-Floor Height

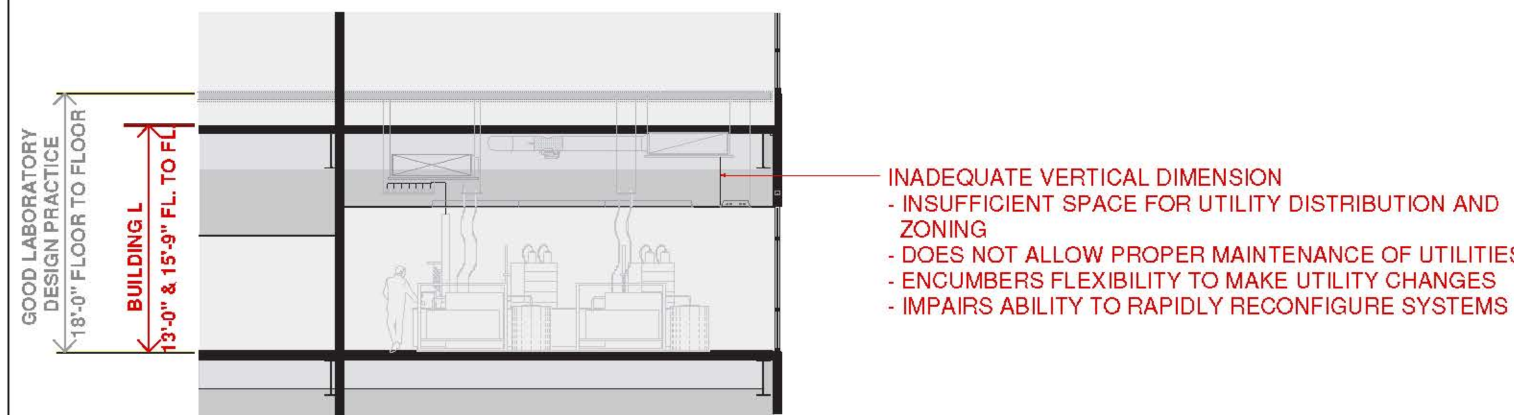


Zone Depth

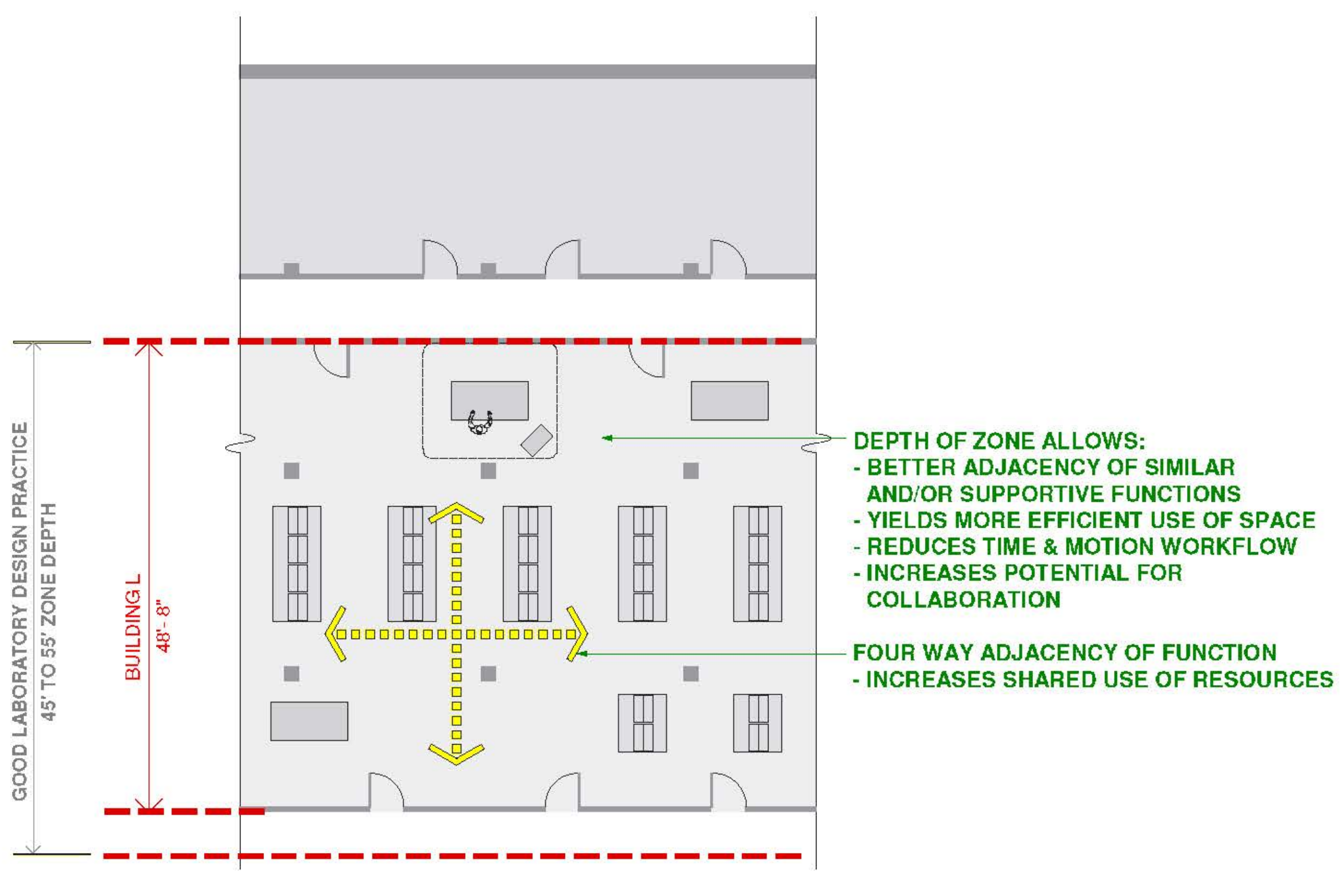
Existing Conditions: Building L



Bay Size

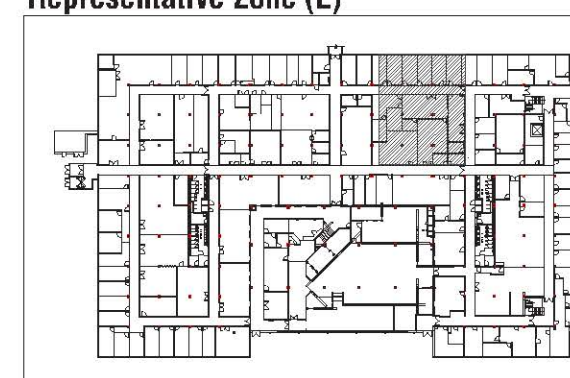


Floor-to-Floor Height

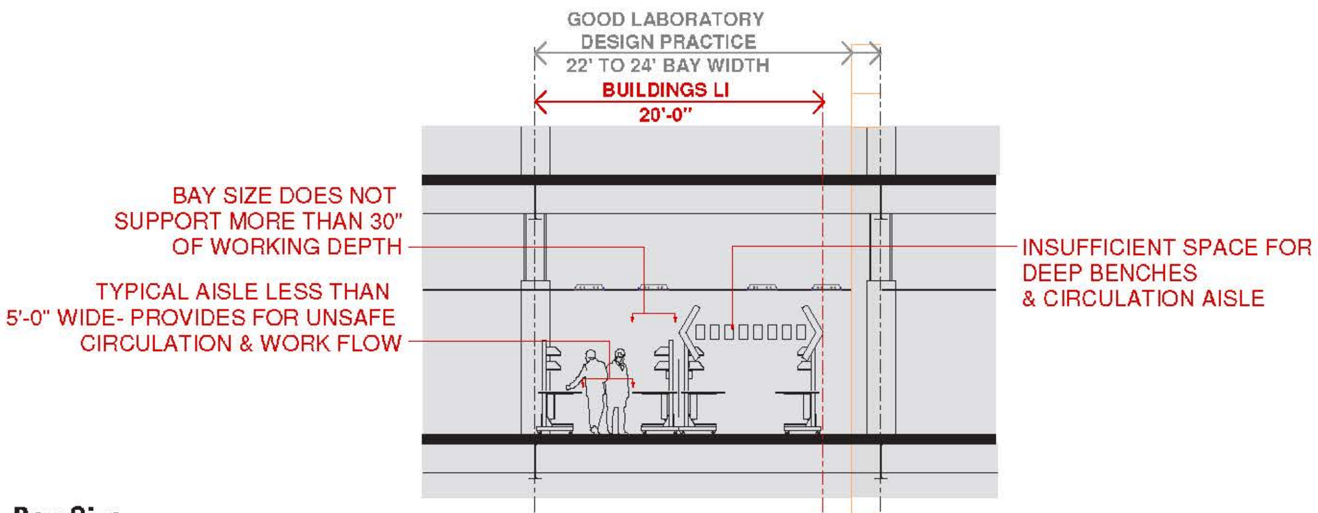


Zone Depth

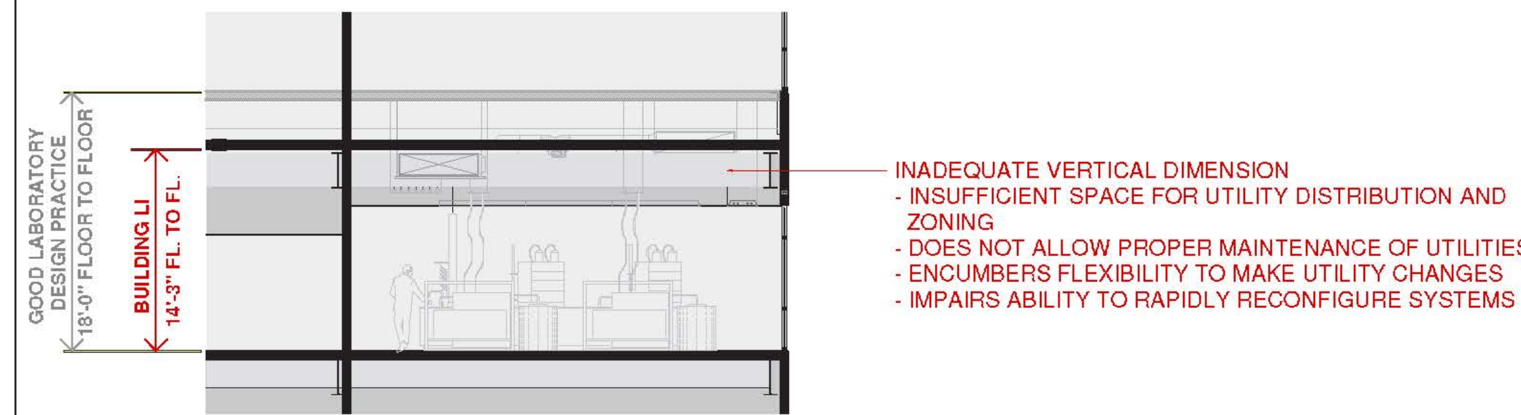
Representative Zone (L)



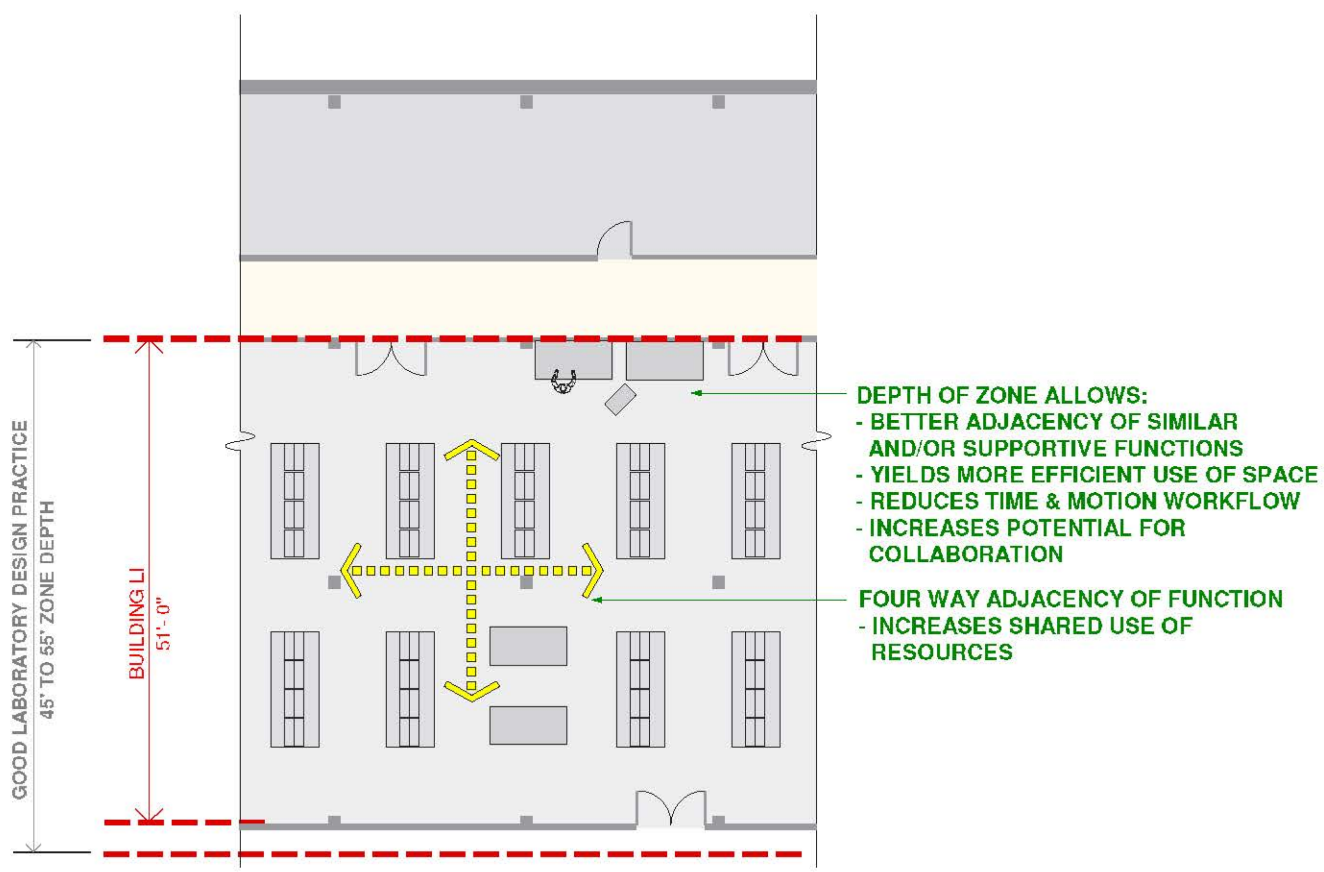
Existing Conditions: Building LI



Bay Size

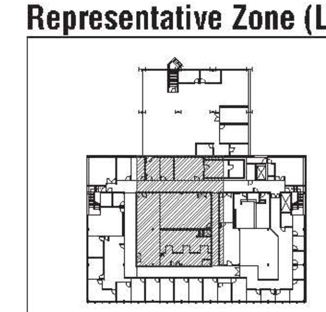


Floor-to-Floor Height

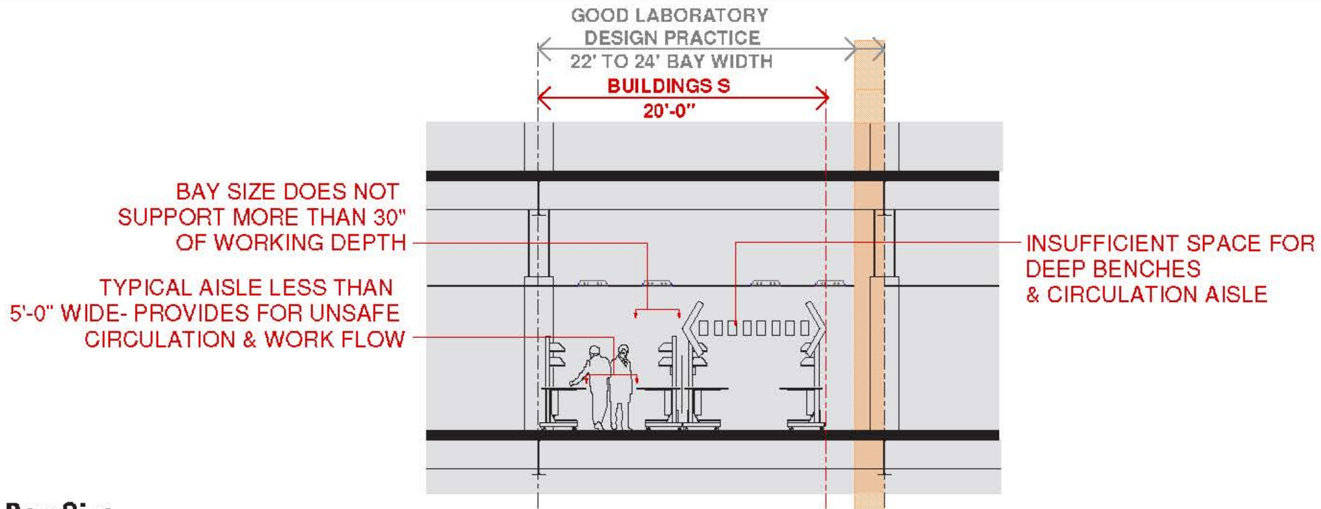


Zone Depth

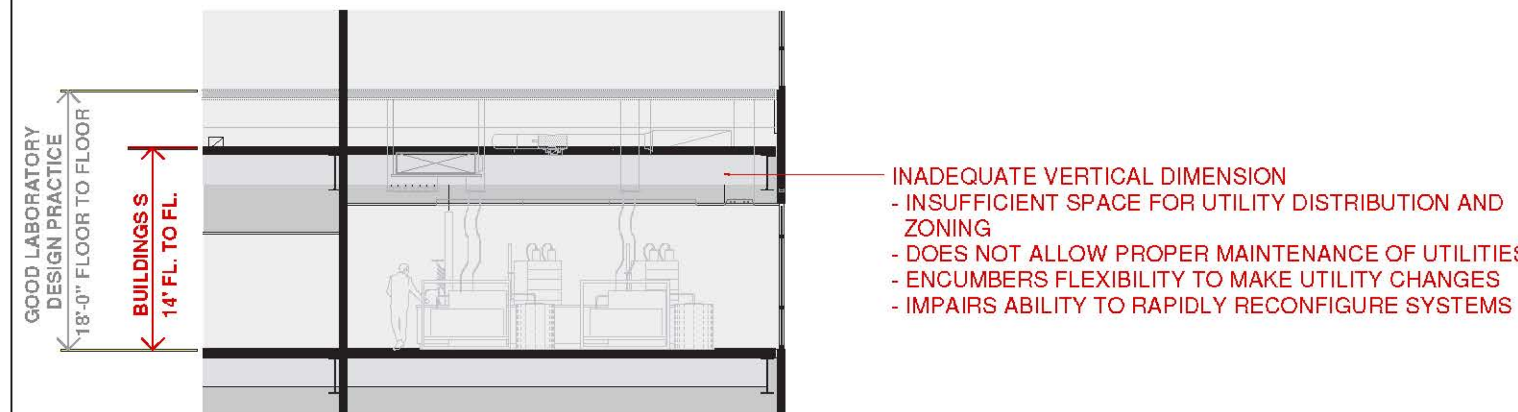
Representative Zone (LI)



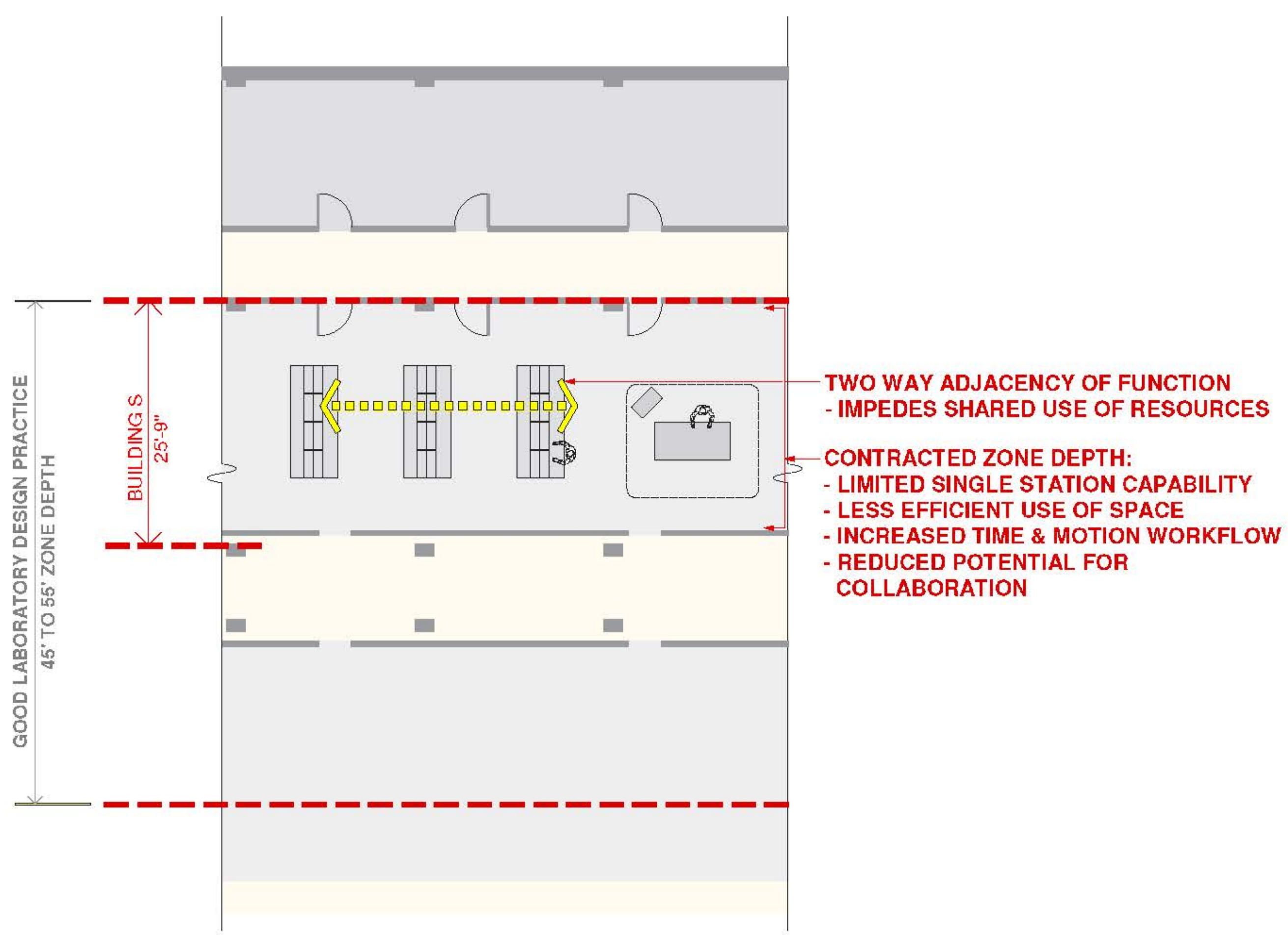
Existing Conditions: Building S



Bay Size

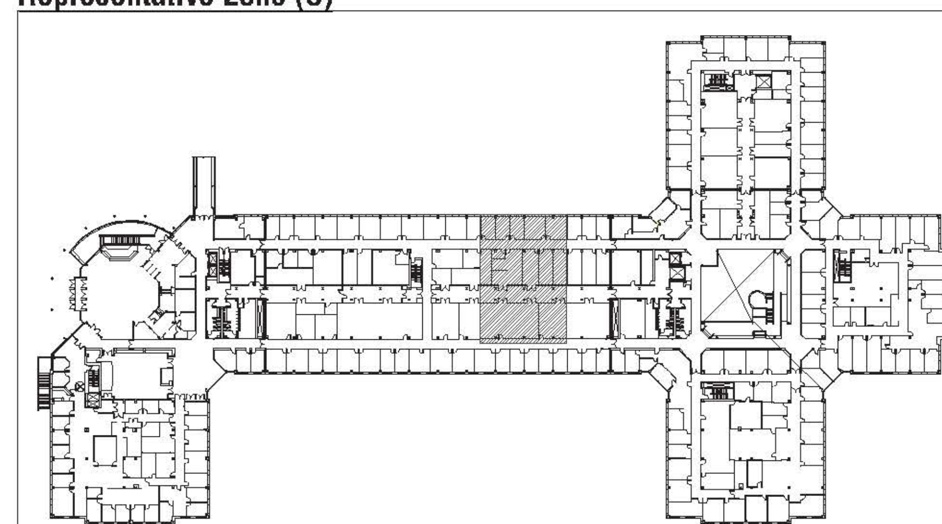


Floor-to-Floor Height



Zone Depth

Representative Zone (S)



Payette Recommendations.
Based on our function analysis, Payette has determined the core buildings of Main Lincoln Laboratory Campus (Buildings A, B, C, and D) are not optimal for the types of research necessary for MIT Lincoln Laboratory. Payette feels the limitations of these buildings, narrow width/extended length and conditions of their systems, is compromising MIT Lincoln Laboratory's full research capabilities.

While our charge was to analyze the existing buildings for function, FEA's Condition Assessment Report of October, 2008 provided useful information on the scope and costs for deferred maintenance. Payette feels this report is a further indication that Buildings A, B, C, D, E, I, and J should be replaced in a timely manner because of code violations, presence of hazardous materials that are no longer allowed in building construction, energy inefficiency, and possibilities of systems failure.

Even if Buildings A, B, C, D, E, I, and J were worth saving, there is not an obvious logistical plan to upgrade the buildings to the extent described in the Condition Assessment Report. These buildings are occupied and without a sufficient and consolidated amount of swing space on campus, the sequence of phasing and relocations would extend for years, perhaps decades, further compounding the problems with deferred maintenance and, consequently, increasing costs. Phasing would also prompt interim space for functions that are very expensive to move, such as:

- Building A: BMS, Security Operations
- Building B: B1: Main PBX and Intranet Server Room; B2: TSAT Sim Lab; B3: Milsat Com Suite
- Roof: Radar Dish, Radomes
- Building C: C1/C3/C4: Clean Room Suites
- Building D: D1: Machine Shop and Fabrication Functions, Specialty ESD Lab; D4: SCIF
- Building E: E1: Polymer Lab, Clean Rooms, Bio Labs
- Building I: High Bay, Integrated Clean Room Facility, Environmental Test Area

Summary.
Payette recommends these buildings be replaced with facilities that will accommodate future state-of-the-art research with a design emphasis based on flexibility - reconfigurable and adaptable to changes in technology, projects, and equipment. Based on what we have learned during our walk-through tours, we recommend flexibility be the basis of design for future buildings in terms of architectural, structural, mechanical, electrical, plumbing, and security systems.

Conclusion.
With upgrades and renovations to the existing buildings, the end result would be a number of buildings in an improved condition, but not optimal or flexible to meet the needs for research.

BUILDINGS FUNCTIONAL ANALYSIS SUMMARY

	OFFICE	LABORATORY	SPECIAL PURPOSE	BUILDING SUPPORT	CONDITION ASSESSMENT [1]	ENERGY EFFICIENCY [2]	CODE [3]	CONFIGURATION ADAPTABILITY [4]	HIGHEST & BEST USE
MAIN BUILDING GROUP									
BUILDING A	Yellow	Red	Yellow	Yellow	Pink	Yellow	Yellow	Red	DEMOLITION
BUILDING P									
BUILDING A - CAFETERIA	Red	Red	Yellow	Yellow	Pink	Yellow	Yellow	Yellow	DEMOLITION/SP
BUILDING B	Yellow	Red	Yellow	Yellow	Pink	Yellow	Yellow	Red	DEMOLITION
BUILDING K									
BUILDING C	Yellow	Red	Yellow	Yellow	Pink	Yellow	Yellow	Red	DEMOLITION
BUILDING D	Yellow	Red	Yellow	Yellow	Pink	Yellow	Pink	Red	DEMOLITION
BUILDING E	Yellow	Red	Yellow	Yellow	Red	Yellow	Pink	Yellow	DEMOLITION
BUILDING M									
BUILDING F	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	OFFICE
BUILDING FA	Green	Green	Green	Green	Blue	Yellow	Pink	Green	LAB/OFFICE
BUILDING I	Yellow	Yellow	Green	Green	Pink	Yellow	Pink	Red	DEMOLITION
BUILDING J	Green	Yellow	Yellow	Yellow	Pink	Yellow	Yellow	Red	DEMOLITION
BUILDING L	Green	Yellow	Green	Green	Yellow	Yellow	Pink	Green	(OFFICE)
BUILDING LI	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow	Yellow	(SP)
BUILDING ML	Green	Green	Green	Green	Blue	Yellow	Blue	Green	LAB
BUILDING S	Green	Yellow	Green	Green	Blue	Blue	Yellow	Green	OFFICE/LAB
CHILLED WATER PLANT	Yellow	Yellow	Green	Green	Blue	Yellow	Yellow	Yellow	SP
ANNEX BUILDING GROUP									
KH1	Green	Red	Yellow	Green	Blue	Yellow	Blue	Yellow	OFFICE
ANNEX 3	Yellow	Red	Yellow	Yellow	Pink	Yellow	Yellow	Red	SP
ANNEX 4	Yellow	Red	Yellow	Yellow	Pink	Pink	Pink	Red	SP
ANNEX 6	Yellow	Red	Yellow	Yellow	Pink	Yellow	Yellow	Red	SP
BUILDING V	Green	Red	Yellow	Green	Pink	Yellow	Yellow	Yellow	OFFICE
BALLOON HOUSE	Red	Red	Red	Red	Red	Yellow	Yellow	Red	(SP)
LEXINGTON FIELD STATION	Yellow	Red	Yellow	Yellow	Pink	Yellow	Yellow	Red	(SP)
LEASED BUILDING GROUP									
BUILDING 1715	Green	Green	Green	Green	White	White	White	Green	LAB/SP
BUILDING 1718	Green	Green	Green	Green	White	White	White	Green	LAB/SP

SYMBOLS LEGEND

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Blue	GOOD COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Pink	BELOW AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE
White	UNRATED COMPATIBILITY/ COMPLIANCE

Footnotes

1. Condition Assessment evaluation is obtained from the Facility Condition Assessment for Lincoln Laboratory by Facility Engineering Associates (FEA). Payette has reviewed this report and concurs with its conclusions.

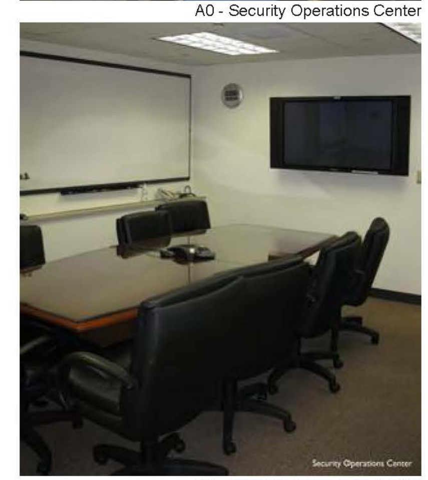
2. Energy Efficiency evaluation is based on Payette's review of the individual building evaluations in the Facility Condition Assessment for Lincoln Laboratory by FEA.

3. Code Evaluation is based on Payette's review of the individual building evaluations in the Facility Condition Assessment for Lincoln Laboratory by FEA and Payette's review of the individual building floor plans along with building walkthrough observations. This does not constitute a thorough code review that is recommended as buildings are to be considered for renovation.

4. Configuration Adaptability is based on Payette's review and analysis of the individual building floor plans.

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

A0 - Security Operations Center



A0 - Security Operations Center

A0 - Facilities Operations Center

A2

A2

BUILDING A

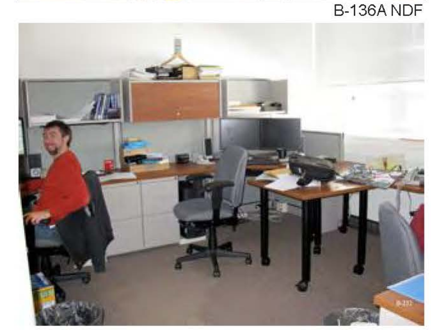
	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	● yellow	● green	● green		
2 MOD					
3 MOD					
CAVES & COMMONS	● yellow	● yellow	● green		
LABORATORY					
ANECHOIC CHAMBER	● red	● red	● red		
ANTENNA ENCL/CONTROL	● yellow	● yellow	● yellow		
ASSEMBLY/PREP	● yellow	● yellow	● yellow		
BIOLOGICAL	● red	● yellow	● red		
CLEAN ROOM	● red	● red	● red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	● red	● yellow	● green		
EPITAXIAL					
HANGAR					
HIGH BAY	● red	● yellow	● red		
LASER					
MATERIALS LAB	● red	● yellow	● yellow		
MICRO ELECTRONICS					
OPTICS	● red	● yellow	● green		
PROCESS SUPPORT	● red	● yellow	● red		
WET CHEM/MATL PREP	● red	● yellow	● red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	● green	● green	● green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	● green	● green	● green		
EQUIP TEST/REPAIR	● yellow	● green	● yellow		
FILES/STORAGE	● green	● green	● green		
FOOD SERVICE/VENDING	● yellow	● green	● green		
FSD SUPPORT	● yellow	● green	● green		
GRAPHICS & PUBLICATIONS	● yellow	● green	● green		
LIBRARY/ARCHIVES	● yellow	● yellow	● green		
MACHINE SHOP	● red	● red	● yellow		
OFFICE SUPPORT	● green	● green	● green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	● yellow	● yellow	● yellow		
STOCK ROOM	● yellow	● green	● green		
TELE/DATA SUPPORT	● yellow	● yellow	● yellow		
TOOL ROOM	● red	● red	● red		
TRAINING	● yellow	● yellow	● green		
WORKSTATION AREA	● yellow	● yellow	● green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	● green	● green	● green		
BUILDING SYSTEM	● yellow	● yellow	● yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

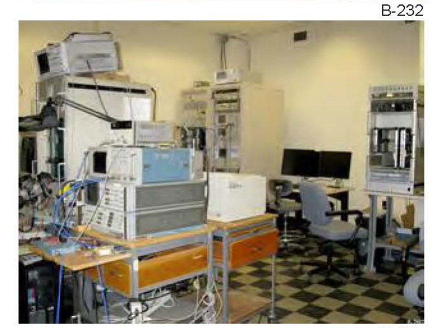
● green	EXCELLENT COMPATIBILITY/ COMPLIANCE
● yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
● red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


B-PBX


B-136A NDF


B-232


B-260


B-260

BUILDING B

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Yellow	Green		
LABORATORY					
ANECHOIC CHAMBER	Red	Red	Red		
ANTENNA ENCL/CONTROL	Yellow	Yellow	Yellow		
ASSEMBLY/PREP	Yellow	Yellow	Yellow		
BIOLOGICAL	Red	Yellow	Red		
CLEAN ROOM	Red	Red	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Red	Yellow	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Red	Yellow	Red		
LASER					
MATERIALS LAB	Red	Yellow	Yellow		
MICRO ELECTRONICS					
OPTICS	Red	Yellow	Green		
PROCESS SUPPORT	Red	Yellow	Red		
WET CHEM/MATL PREP	Red	Yellow	Red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Green	Yellow		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Yellow	Green	Green		
FSD SUPPORT	Yellow	Green	Green		
GRAPHICS & PUBLICATIONS	Yellow	Green	Green		
LIBRARY/ARCHIVES	Yellow	Yellow	Green		
MACHINE SHOP	Red	Red	Yellow		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Yellow	Yellow		
STOCK ROOM	Yellow	Green	Green		
TELE/DATA SUPPORT	Yellow	Yellow	Yellow		
TOOL ROOM	Red	Red	Red		
TRAINING	Yellow	Yellow	Green		
WORKSTATION AREA	Yellow	Yellow	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Yellow	Yellow	Yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

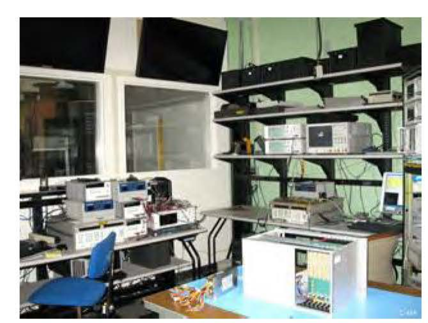
A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

C-182

C-209.B

C-233

C-233



C-434

BUILDING C

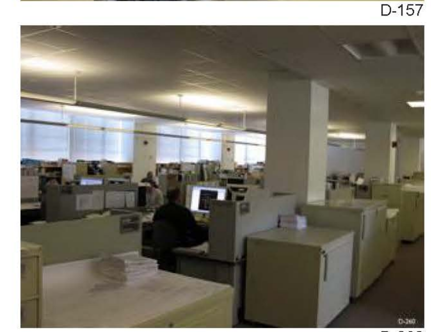
	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟡	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟡	🟡	🟢		
LABORATORY					
ANECHOIC CHAMBER	🔴	🔴	🔴		
ANTENNA ENCL/CONTROL	🟡	🟡	🟡		
ASSEMBLY/PREP	🟡	🟡	🟡		
BIOLOGICAL	🔴	🟡	🔴		
CLEAN ROOM	🔴	🔴	🔴		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🔴	🟡	🟢		
EPITAXIAL					
HANGAR					
HIGH BAY	🔴	🟡	🔴		
LASER					
MATERIALS LAB	🔴	🟡	🟡		
MICRO ELECTRONICS					
OPTICS	🔴	🟡	🟢		
PROCESS SUPPORT	🔴	🟡	🔴		
WET CHEM/MATL PREP	🔴	🟡	🔴		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟡	🟢	🟡		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟡	🟢	🟢		
FSD SUPPORT	🟡	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟡	🟢	🟢		
LIBRARY/ARCHIVES	🟡	🟡	🟢		
MACHINE SHOP	🔴	🔴	🟡		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟡	🟡	🟡		
STOCK ROOM	🟡	🟢	🟢		
TELE/DATA SUPPORT	🟡	🟡	🟡		
TOOL ROOM	🔴	🔴	🔴		
TRAINING	🟡	🟡	🟢		
WORKSTATION AREA	🟡	🟡	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟡	🟡	🟡		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

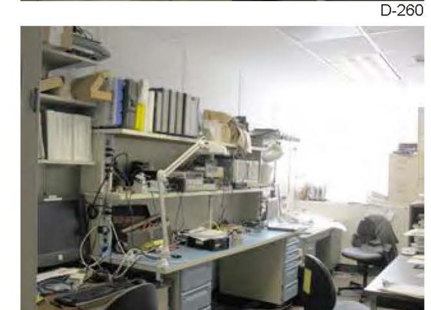
🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE


D-122


D-158


D-157


D-260


D-337

BUILDING D

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Yellow	Green		
LABORATORY					
ANECHOIC CHAMBER	Red	Red	Red		
ANTENNA ENCL/CONTROL	Yellow	Yellow	Yellow		
ASSEMBLY/PREP	Yellow	Yellow	Yellow		
BIOLOGICAL	Red	Yellow	Red		
CLEAN ROOM	Red	Red	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Red	Yellow	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Red	Yellow	Red		
LASER					
MATERIALS LAB	Red	Yellow	Yellow		
MICRO ELECTRONICS					
OPTICS	Red	Yellow	Green		
PROCESS SUPPORT	Red	Yellow	Red		
WET CHEM/MATL PREP	Red	Yellow	Red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Green	Yellow		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Yellow	Green	Green		
FSD SUPPORT	Yellow	Green	Green		
GRAPHICS & PUBLICATIONS	Yellow	Green	Green		
LIBRARY/ARCHIVES	Yellow	Yellow	Green		
MACHINE SHOP	Red	Red	Yellow		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Yellow	Yellow		
STOCK ROOM	Yellow	Green	Green		
TELE/DATA SUPPORT	Yellow	Yellow	Yellow		
TOOL ROOM	Red	Red	Red		
TRAINING	Yellow	Yellow	Green		
WORKSTATION AREA	Yellow	Yellow	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Yellow	Yellow	Yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

E-102

E-107

E-109

E-109

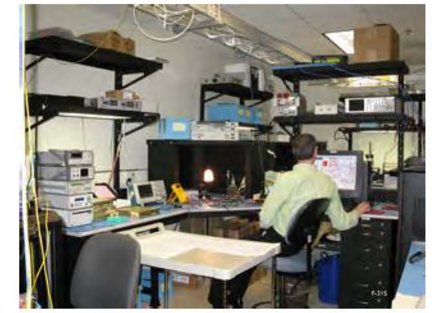
E-200

BUILDING E

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Green	Green		
LABORATORY					
ANECHOIC CHAMBER	Yellow	Yellow	Red		
ANTENNA ENCL/CONTROL	Yellow	Yellow	Yellow		
ASSEMBLY/PREP	Yellow	Green	Yellow		
BIOLOGICAL	Red	Green	Red		
CLEAN ROOM	Yellow	Yellow	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Yellow	Green	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Yellow	Green	Red		
LASER					
MATERIALS LAB	Yellow	Green	Yellow		
MICRO ELECTRONICS					
OPTICS	Yellow	Green	Green		
PROCESS SUPPORT	Yellow	Green	Red		
WET CHEM/MATL PREP	Yellow	Green	Red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Green	Green	Yellow		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Green	Green		
LIBRARY/ARCHIVES	Green	Green	Green		
MACHINE SHOP	Yellow	Yellow	Yellow		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Green	Green	Yellow		
STOCK ROOM	Green	Green	Green		
TELE/DATA SUPPORT	Green	Green	Yellow		
TOOL ROOM	Yellow	Yellow	Red		
TRAINING	Green	Green	Green		
WORKSTATION AREA	Yellow	Green	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Green	Green	Yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

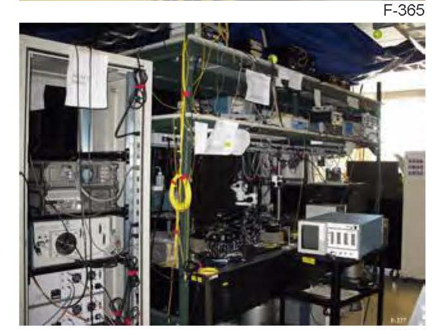
- Green: EXCELLENT COMPATIBILITY/ COMPLIANCE
- Yellow: AVERAGE COMPATIBILITY/ COMPLIANCE
- Red: POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


F-315

F-343


F-365


F-377


F-377

BUILDING F

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	EXCELLENT	AVERAGE	EXCELLENT		
2 MOD					
3 MOD					
CAVES & COMMONS	EXCELLENT	AVERAGE	EXCELLENT		
LABORATORY					
ANECHOIC CHAMBER	POOR	AVERAGE	AVERAGE		
ANTENNA ENCL/CONTROL	AVERAGE	AVERAGE	EXCELLENT		
ASSEMBLY/PREP	AVERAGE	AVERAGE	EXCELLENT		
BIOLOGICAL	AVERAGE	EXCELLENT	EXCELLENT		
CLEAN ROOM	AVERAGE	AVERAGE	AVERAGE		
COMPUTER LAB					
ELECTRONICS SYSTEMS	AVERAGE	EXCELLENT	EXCELLENT		
EPITAXIAL					
HANGAR					
HIGH BAY	AVERAGE	AVERAGE	POOR		
LASER					
MATERIALS LAB	AVERAGE	AVERAGE	EXCELLENT		
MICRO ELECTRONICS					
OPTICS	AVERAGE	AVERAGE	EXCELLENT		
PROCESS SUPPORT	AVERAGE	AVERAGE	EXCELLENT		
WET CHEM/MATL PREP	AVERAGE	AVERAGE	EXCELLENT		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	EXCELLENT	AVERAGE	EXCELLENT		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	EXCELLENT	AVERAGE	EXCELLENT		
EQUIP TEST/REPAIR	AVERAGE	AVERAGE	EXCELLENT		
FILES/STORAGE	EXCELLENT	EXCELLENT	EXCELLENT		
FOOD SERVICE/VENDING	EXCELLENT	EXCELLENT	EXCELLENT		
FSD SUPPORT	EXCELLENT	AVERAGE	EXCELLENT		
GRAPHICS & PUBLICATIONS	EXCELLENT	AVERAGE	EXCELLENT		
LIBRARY/ARCHIVES	AVERAGE	AVERAGE	EXCELLENT		
MACHINE SHOP	AVERAGE	POOR	AVERAGE		
OFFICE SUPPORT	EXCELLENT	AVERAGE	EXCELLENT		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	AVERAGE	AVERAGE	EXCELLENT		
STOCK ROOM	EXCELLENT	AVERAGE	EXCELLENT		
TELE/DATA SUPPORT	EXCELLENT	EXCELLENT	EXCELLENT		
TOOL ROOM	EXCELLENT	AVERAGE	AVERAGE		
TRAINING	EXCELLENT	AVERAGE	EXCELLENT		
WORKSTATION AREA	EXCELLENT	AVERAGE	EXCELLENT		
BUILDING SUPPORT					
PRIMARY CIRCULATION	EXCELLENT	EXCELLENT	EXCELLENT		
BUILDING SYSTEM	AVERAGE	AVERAGE	EXCELLENT		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

EXCELLENT COMPATIBILITY/ COMPLIANCE
AVERAGE COMPATIBILITY/ COMPLIANCE
POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

FA-130

FA-130

FA-130

FA-130

FA-130

BUILDING FA

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟢	🟢	🟢		
LABORATORY					
ANECHOIC CHAMBER	🟢	🟡	🟡		
ANTENNA ENCL/CONTROL	🟢	🟢	🟢		
ASSEMBLY/PREP	🟢	🟢	🟢		
BIOLOGICAL	🟢	🟢	🟢		
CLEAN ROOM	🟢	🟡	🔴		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟢	🟢	🟢		
EPITAXIAL					
HANGAR					
HIGH BAY	🟢	🟡	🟡		
LASER					
MATERIALS LAB	🟢	🟢	🟢		
MICRO ELECTRONICS					
OPTICS	🟢	🟢	🟢		
PROCESS SUPPORT	🟢	🟢	🟢		
WET CHEM/MATL PREP	🟢	🟢	🟢		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟢	🟢	🟢		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟢	🟢	🟢		
FSD SUPPORT	🟢	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟢	🟢	🟢		
LIBRARY/ARCHIVES	🟢	🟢	🟢		
MACHINE SHOP	🟢	🟡	🟡		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟢	🟡	🟢		
STOCK ROOM	🟢	🟢	🟢		
TELE/DATA SUPPORT	🟢	🟢	🟢		
TOOL ROOM	🟢	🟢	🟢		
TRAINING	🟢	🟢	🟢		
WORKSTATION AREA	🟢	🟢	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟢	🟢	🟢		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


I


I - Clean Room


I - Clean Room Support


I - Satellite Workshop


I - Basement Storage

BUILDING I

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Yellow	Green		
LABORATORY					
ANECHOIC CHAMBER	Red	Yellow	Yellow		
ANTENNA ENCL/CONTROL	Yellow	Green	Yellow		
ASSEMBLY/PREP	Yellow	Green	Green		
BIOLOGICAL	Yellow	Green	Green		
CLEAN ROOM	Red	Yellow	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Yellow	Green	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Yellow	Green	Yellow		
LASER					
MATERIALS LAB	Yellow	Green	Green		
MICRO ELECTRONICS					
OPTICS	Yellow	Green	Green		
PROCESS SUPPORT	Yellow	Green	Green		
WET CHEM/MATL PREP	Yellow	Green	Yellow		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Green	Green		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Green	Green		
LIBRARY/ARCHIVES	Green	Green	Green		
MACHINE SHOP	Red	Green	Green		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Green	Yellow		
STOCK ROOM	Green	Green	Green		
TELE/DATA SUPPORT	Green	Green	Yellow		
TOOL ROOM	Yellow	Green	Red		
TRAINING	Green	Green	Green		
WORKSTATION AREA	Yellow	Green	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Green	Green	Green		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

J - Corridor

J - Exterior

J - Exterior

J - Exterior

BUILDING J

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Green	Green		
LABORATORY					
ANECHOIC CHAMBER	Red	Yellow	Red		
ANTENNA ENCL/CONTROL	Yellow	Green	Yellow		
ASSEMBLY/PREP	Yellow	Green	Yellow		
BIOLOGICAL	Yellow	Green	Green		
CLEAN ROOM	Red	Yellow	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Yellow	Green	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Yellow	Yellow	Red		
LASER					
MATERIALS LAB	Yellow	Yellow	Red		
MICRO ELECTRONICS					
OPTICS	Yellow	Green	Yellow		
PROCESS SUPPORT	Yellow	Green	Yellow		
WET CHEM/MATL PREP	Yellow	Green	Yellow		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Green	Green		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Green	Green		
LIBRARY/ARCHIVES	Yellow	Green	Green		
MACHINE SHOP	Red	Yellow	Yellow		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Green	Yellow		
STOCK ROOM	Yellow	Green	Green		
TELE/DATA SUPPORT	Green	Green	Yellow		
TOOL ROOM	Yellow	Green	Red		
TRAINING	Green	Green	Green		
WORKSTATION AREA	Yellow	Green	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Yellow	Green	Yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

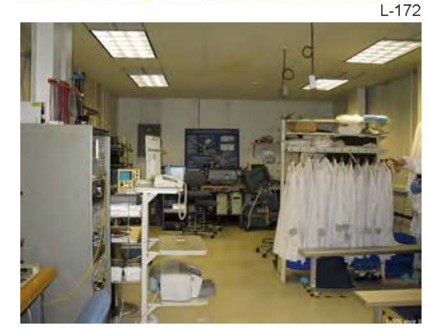
Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


L-123


L-168


L-172


L-205

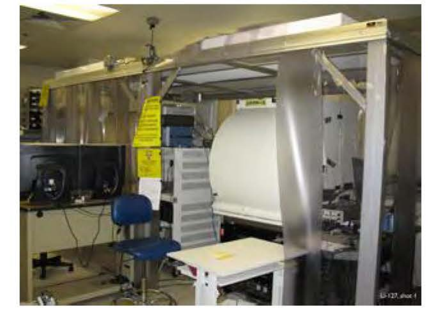

L-205

BUILDING L

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟢	🟢	🟢		
LABORATORY					
ANECHOIC CHAMBER	🔴	🟡	🔴		
ANTENNA ENCL/CONTROL	🟡		🟡		
ASSEMBLY/PREP	🟡	🟡	🟡		
BIOLOGICAL	🟢	🟢	🔴		
CLEAN ROOM	🟡	🟢	🔴		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟡	🟡	🟢		
EPITAXIAL					
HANGAR					
HIGH BAY	🟡	🟡	🔴		
LASER					
MATERIALS LAB	🟡	🟡	🟡		
MICRO ELECTRONICS					
OPTICS	🟡	🟢	🟢		
PROCESS SUPPORT	🟡	🟢	🔴		
WET CHEM/MATL PREP	🟢	🟢	🔴		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟡	🟢	🟡		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟢	🟢	🟢		
FSD SUPPORT	🟢	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟢	🟢	🟢		
LIBRARY/ARCHIVES	🟢	🟢	🟢		
MACHINE SHOP	🟡	🟡	🟡		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟢	🟡	🟡		
STOCK ROOM	🟢	🟢	🟢		
TELE/DATA SUPPORT	🟢	🟢	🟡		
TOOL ROOM	🟡	🟡	🔴		
TRAINING	🟢	🟢	🟢		
WORKSTATION AREA	🟢	🟡	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟢	🟡	🟡		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS



LI-127

LI-135.A

LI-233.B

LI-234

LI-281.B

BUILDING LI

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	green	yellow	green		
2 MOD					
3 MOD					
CAVES & COMMONS	green	yellow	green		
LABORATORY					
ANECHOIC CHAMBER	red	yellow	yellow		
ANTENNA ENCL/CONTROL	yellow	yellow	yellow		
ASSEMBLY/PREP	yellow	yellow	yellow		
BIOLOGICAL	yellow	yellow	yellow		
CLEAN ROOM	yellow	yellow	red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	yellow	yellow	green		
EPITAXIAL					
HANGAR					
HIGH BAY	red	yellow	red		
LASER					
MATERIALS LAB	yellow	yellow	yellow		
MICRO ELECTRONICS					
OPTICS	yellow	yellow	green		
PROCESS SUPPORT	yellow	yellow	yellow		
WET CHEM/MATL PREP	yellow	yellow	yellow		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	green				
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	green	green	green		
EQUIP TEST/REPAIR	yellow	green	green		
FILES/STORAGE	green	green	green		
FOOD SERVICE/VENDING	green	green	green		
FSD SUPPORT	green	green	green		
GRAPHICS & PUBLICATIONS	green	green	green		
LIBRARY/ARCHIVES	green	green	green		
MACHINE SHOP	red	yellow	yellow		
OFFICE SUPPORT	green	green	green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	yellow	yellow	yellow		
STOCK ROOM	green	green	green		
TELE/DATA SUPPORT	green	green	green		
TOOL ROOM	green	green	green		
TRAINING	green	green	green		
WORKSTATION AREA	green	yellow	green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	green	green	green		
BUILDING SYSTEM	yellow	yellow	yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

green	EXCELLENT COMPATIBILITY/ COMPLIANCE
yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

ML-117

ML-117

ML-117

ML-117

BUILDING ML

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟢	🟢	🟢		
LABORATORY					
ANECHOIC CHAMBER	🟢	🟢	🟡		
ANTENNA ENCL/CONTROL	🟢	🟢	🟢		
ASSEMBLY/PREP	🟢	🟢	🟢		
BIOLOGICAL	🟢	🟢	🟢		
CLEAN ROOM	🟢	🟢	🟢		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟢	🟢	🟢		
EPITAXIAL					
HANGAR					
HIGH BAY	🟢	🟢	🟡		
LASER					
MATERIALS LAB	🟢	🟢	🟢		
MICRO ELECTRONICS					
OPTICS	🟢	🟢	🟢		
PROCESS SUPPORT	🟢	🟢	🟢		
WET CHEM/MATL PREP	🟢	🟢	🟢		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟢	🟢	🟢		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟢	🟢	🟢		
FSD SUPPORT	🟢	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟢	🟢	🟢		
LIBRARY/ARCHIVES	🟢	🟢	🟢		
MACHINE SHOP	🟢	🟢	🟢		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟢	🟢	🟢		
STOCK ROOM	🟢	🟢	🟢		
TELE/DATA SUPPORT	🟢	🟢	🟢		
TOOL ROOM	🟢	🟢	🟢		
TRAINING	🟢	🟢	🟢		
WORKSTATION AREA	🟢	🟢	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟢	🟢	🟢		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE

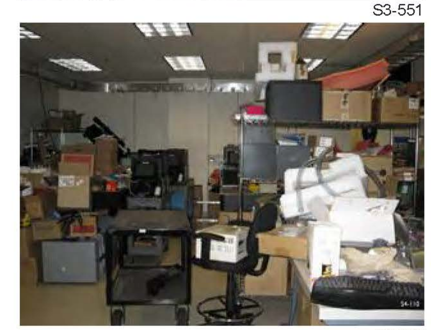
A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

S0-326 MDF


S1-527


S3-510


S3-551


S4-110

BUILDING S

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Green	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Green	Yellow	Green		
LABORATORY					
ANECHOIC CHAMBER	Yellow	Red	Red		
ANTENNA ENCL/CONTROL	Green	Yellow	Yellow		
ASSEMBLY/PREP	Green	Yellow	Green		
BIOLOGICAL	Green	Yellow	Green		
CLEAN ROOM	Green	Red	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Green	Green	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Yellow	Yellow	Red		
LASER					
MATERIALS LAB	Green	Green	Green		
MICRO ELECTRONICS					
OPTICS	Green	Green	Green		
PROCESS SUPPORT	Yellow	Yellow	Green		
WET CHEM/MATL PREP	Green	Yellow	Yellow		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green				
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Yellow	Green		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Green	Green		
LIBRARY/ARCHIVES	Green	Green	Green		
MACHINE SHOP	Yellow	Yellow	Yellow		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Green	Yellow	Green		
STOCK ROOM	Green	Green	Green		
TELE/DATA SUPPORT	Green	Green	Green		
TOOL ROOM	Green	Green	Green		
TRAINING	Green	Green	Green		
WORKSTATION AREA	Green	Green	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Green	Green	Green		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

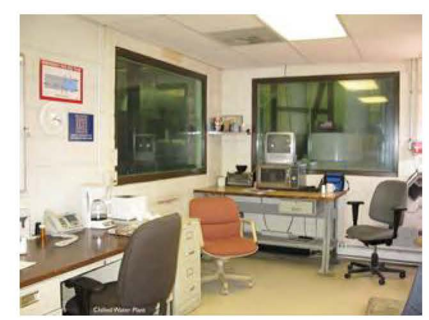
Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


Chilled Water Plant


Chilled Water Plant


Chilled Water Plant


Chilled Water Plant - Control Room


Electrical Building

BUILDING CWP

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Yellow	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Yellow	Green		
LABORATORY					
ANECHOIC CHAMBER	Yellow	Yellow	Green		
ANTENNA ENCL/CONTROL	Yellow	Green	Green		
ASSEMBLY/PREP	Yellow	Green	Green		
BIOLOGICAL	Red	Green	Green		
CLEAN ROOM	Yellow	Green	Green		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Red	Green	Green		
EPITAXIAL					
HANGAR					
HIGH BAY	Yellow	Yellow	Green		
LASER					
MATERIALS LAB	Yellow	Green	Green		
MICRO ELECTRONICS					
OPTICS	Yellow	Green	Green		
PROCESS SUPPORT	Yellow	Green	Green		
WET CHEM/MATL PREP	Red	Green	Green		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Green	Green		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Green	Green		
LIBRARY/ARCHIVES	Yellow	Green	Green		
MACHINE SHOP	Red	Green	Green		
OFFICE SUPPORT	Yellow	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Green	Green		
STOCK ROOM	Yellow	Green	Green		
TELE/DATA SUPPORT	Green	Green	Green		
TOOL ROOM	Yellow	Green	Green		
TRAINING	Yellow	Green	Green		
WORKSTATION AREA	Yellow	Green	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Green	Green	Green		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

KH1-135

KH1-135

KH1-235

AN-175

AN-175

BUILDING KH1

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Green	Green	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Green	Green	Yellow		
LABORATORY					
ANECHOIC CHAMBER	Red	Yellow	Red		
ANTENNA ENCL/CONTROL	Yellow	Yellow	Red		
ASSEMBLY/PREP	Yellow	Yellow	Yellow		
BIOLOGICAL	Yellow	Yellow	Red		
CLEAN ROOM	Yellow	Yellow	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Yellow	Yellow	Yellow		
EPITAXIAL					
HANGAR					
HIGH BAY	Red	Yellow	Red		
LASER					
MATERIALS LAB	Yellow	Yellow	Red		
MICRO ELECTRONICS					
OPTICS	Yellow	Yellow	Yellow		
PROCESS SUPPORT	Yellow	Yellow	Red		
WET CHEM/MATL PREP	Yellow	Yellow	Red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Green	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Yellow	Green		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Green	Green		
LIBRARY/ARCHIVES	Green	Green	Green		
MACHINE SHOP	Yellow	Yellow	Red		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Yellow	Red		
STOCK ROOM	Green	Yellow	Yellow		
TELE/DATA SUPPORT	Green	Green	Yellow		
TOOL ROOM	Yellow	Yellow	Yellow		
TRAINING	Green	Green	Green		
WORKSTATION AREA	Green	Green	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Green	Green		
BUILDING SYSTEM	Green	Green	Yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

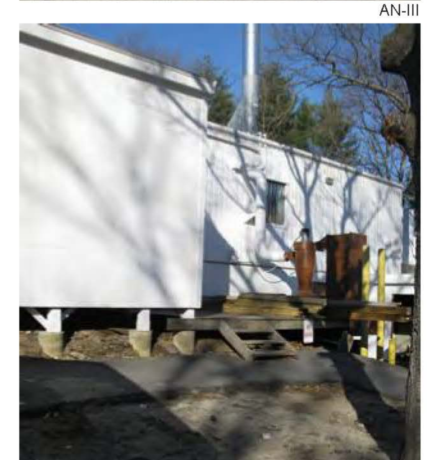
A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

AN-III

AN-III

AN-III

AN-III



AN-III

BUILDING ANNEX 3

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	green	yellow	green		
2 MOD					
3 MOD					
CAVES & COMMONS	green	yellow	yellow		
LABORATORY					
ANECHOIC CHAMBER	red	red	red		
ANTENNA ENCL/CONTROL	yellow	red	red		
ASSEMBLY/PREP	yellow	red	red		
BIOLOGICAL	yellow	red	red		
CLEAN ROOM	yellow	red	red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	yellow	yellow	red		
EPITAXIAL					
HANGAR					
HIGH BAY	red	red	red		
LASER					
MATERIALS LAB	yellow	red	red		
MICRO ELECTRONICS					
OPTICS	yellow	yellow	red		
PROCESS SUPPORT	yellow	red	red		
WET CHEM/MATL PREP	yellow	red	red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	green	yellow	green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	green	green	green		
EQUIP TEST/REPAIR	yellow	yellow	red		
FILES/STORAGE	green	green	green		
FOOD SERVICE/VENDING	green	green	green		
FSD SUPPORT	green	green	green		
GRAPHICS & PUBLICATIONS	green	yellow	green		
LIBRARY/ARCHIVES	green	yellow	yellow		
MACHINE SHOP	yellow	red	red		
OFFICE SUPPORT	green	green	green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	yellow	yellow	yellow		
STOCK ROOM	green	yellow	yellow		
TELE/DATA SUPPORT	green	green	green		
TOOL ROOM	yellow	yellow	yellow		
TRAINING	green	yellow	green		
WORKSTATION AREA	green	yellow	green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	green	green	green		
BUILDING SYSTEM	green	yellow	yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

- green: EXCELLENT COMPATIBILITY/ COMPLIANCE
- yellow: AVERAGE COMPATIBILITY/ COMPLIANCE
- red: POOR COMPATIBILITY/ COMPLIANCE

AN-IV

AN-IV

AN-IV

AN-IV

BUILDING ANNEX 4

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟡	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟡	🟡	🟡		
LABORATORY					
ANECHOIC CHAMBER	🔴	🔴	🔴		
ANTENNA ENCL/CONTROL	🟡	🔴	🔴		
ASSEMBLY/PREP	🟡	🔴	🔴		
BIOLOGICAL	🟡	🔴	🔴		
CLEAN ROOM		🔴	🔴		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟡	🟡	🔴		
EPITAXIAL					
HANGAR					
HIGH BAY	🔴	🔴	🔴		
LASER					
MATERIALS LAB	🟡	🔴	🔴		
MICRO ELECTRONICS					
OPTICS	🟡	🟡	🔴		
PROCESS SUPPORT	🟡	🔴	🔴		
WET CHEM/MATL PREP	🟡	🔴	🔴		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟡	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟡	🟢		
EQUIP TEST/REPAIR	🟡	🟡	🔴		
FILES/STORAGE	🟢	🟡	🟢		
FOOD SERVICE/VENDING	🟢	🟡	🟢		
FSD SUPPORT	🟢	🟡	🟢		
GRAPHICS & PUBLICATIONS	🟡	🟡	🟡		
LIBRARY/ARCHIVES	🟡	🟡	🟡		
MACHINE SHOP	🟡	🔴	🔴		
OFFICE SUPPORT	🟢	🟡	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟡	🟡	🟡		
STOCK ROOM	🟡	🟡	🟡		
TELE/DATA SUPPORT	🟢	🟢	🟢		
TOOL ROOM	🟡	🟡	🟡		
TRAINING	🟢	🟡	🟢		
WORKSTATION AREA	🟢	🟡	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟡	🟢		
BUILDING SYSTEM	🟢	🟡	🟡		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE


AN-VI


AN-VI


AN-VI


AN-VI Trailer


AN-VI

BUILDING ANNEX 6

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Green	Yellow	Green		
2 MOD					
3 MOD					
CAVES & COMMONS	Green	Yellow	Yellow		
LABORATORY					
ANECHOIC CHAMBER	Red	Red	Red		
ANTENNA ENCL/CONTROL	Yellow	Red	Red		
ASSEMBLY/PREP	Yellow	Red	Red		
BIOLOGICAL	Yellow	Red	Red		
CLEAN ROOM	Yellow	Red	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Yellow	Yellow	Red		
EPITAXIAL					
HANGAR					
HIGH BAY	Red	Red	Red		
LASER					
MATERIALS LAB	Yellow	Red	Red		
MICRO ELECTRONICS					
OPTICS	Yellow	Yellow	Red		
PROCESS SUPPORT	Yellow	Red	Red		
WET CHEM/MATL PREP	Yellow	Red	Red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Green	Yellow	Green		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Green	Green	Green		
EQUIP TEST/REPAIR	Yellow	Yellow	Red		
FILES/STORAGE	Green	Green	Green		
FOOD SERVICE/VENDING	Green	Green	Green		
FSD SUPPORT	Green	Green	Green		
GRAPHICS & PUBLICATIONS	Green	Yellow	Green		
LIBRARY/ARCHIVES	Green	Yellow	Yellow		
MACHINE SHOP	Yellow	Red	Red		
OFFICE SUPPORT	Green	Green	Green		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Yellow	Yellow		
STOCK ROOM	Green	Yellow	Yellow		
TELE/DATA SUPPORT	Green	Green	Green		
TOOL ROOM	Yellow	Yellow	Yellow		
TRAINING	Green	Yellow	Green		
WORKSTATION AREA	Green	Yellow	Green		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Green	Yellow	Green		
BUILDING SYSTEM	Green	Yellow	Yellow		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


V


V


V

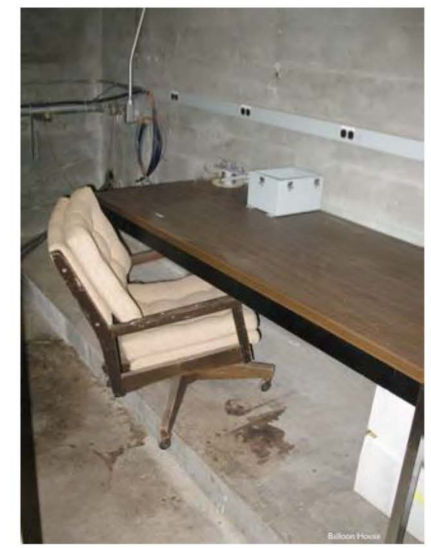

V

BUILDING V

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟢	🟡	🟡		
LABORATORY					
ANECHOIC CHAMBER	🔴	🔴	🔴		
ANTENNA ENCL/CONTROL	🟡	🔴	🔴		
ASSEMBLY/PREP	🟡	🔴	🔴		
BIOLOGICAL	🟡	🔴	🔴		
CLEAN ROOM	🟡	🔴	🔴		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟡	🟡	🔴		
EPITAXIAL					
HANGAR					
HIGH BAY	🔴	🔴	🔴		
LASER					
MATERIALS LAB	🟡	🔴	🔴		
MICRO ELECTRONICS					
OPTICS	🟡	🟡	🔴		
PROCESS SUPPORT	🟡	🔴	🔴		
WET CHEM/MATL PREP	🟡	🔴	🔴		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢			
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟡	🟡	🔴		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟢	🟢	🟢		
FSD SUPPORT	🟢	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟢	🟢	🟢		
LIBRARY/ARCHIVES	🟢	🟢	🟡		
MACHINE SHOP	🟡	🔴	🔴		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟡	🟡	🟡		
STOCK ROOM	🟢	🟢	🟡		
TELE/DATA SUPPORT	🟢	🟢	🟢		
TOOL ROOM	🟡	🟡	🟡		
TRAINING	🟢	🟢	🟢		
WORKSTATION AREA	🟢	🟡	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟢	🟢	🟡		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE

Balloon House - Antenna Storage



Balloon House

Balloon House

BUILDING BALLOON HOUSE

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🔴	🔴	🔴		
2 MOD					
3 MOD					
CAVES & COMMONS	🔴	🔴	🔴		
LABORATORY					
ANECHOIC CHAMBER	🔴	🔴	🔴		
ANTENNA ENCL/CONTROL	🔴	🔴	🔴		
ASSEMBLY/PREP	🔴	🔴	🔴		
BIOLOGICAL	🔴	🔴	🔴		
CLEAN ROOM	🔴	🔴	🔴		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🔴	🔴	🔴		
EPITAXIAL					
HANGAR					
HIGH BAY	🔴	🔴	🔴		
LASER					
MATERIALS LAB	🔴	🔴	🔴		
MICRO ELECTRONICS					
OPTICS	🔴	🔴	🔴		
PROCESS SUPPORT	🔴	🔴	🔴		
WET CHEM/MATL PREP	🔴	🔴	🔴		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE		🔴			
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🔴	🔴	🔴		
EQUIP TEST/REPAIR	🔴	🔴	🔴		
FILES/STORAGE	🔴	🔴	🔴		
FOOD SERVICE/VENDING	🔴	🔴	🔴		
FSD SUPPORT	🔴	🔴	🔴		
GRAPHICS & PUBLICATIONS	🔴	🔴	🔴		
LIBRARY/ARCHIVES	🔴	🔴	🔴		
MACHINE SHOP	🔴	🔴	🔴		
OFFICE SUPPORT	🔴	🔴	🔴		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🔴	🔴	🔴		
STOCK ROOM	🔴	🔴	🔴		
TELE/DATA SUPPORT	🔴	🔴	🔴		
TOOL ROOM	🔴	🔴	🔴		
TRAINING	🔴	🔴	🔴		
WORKSTATION AREA	🔴	🔴	🔴		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🔴	🔴	🔴		
BUILDING SYSTEM	🔴	🔴	🔴		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE

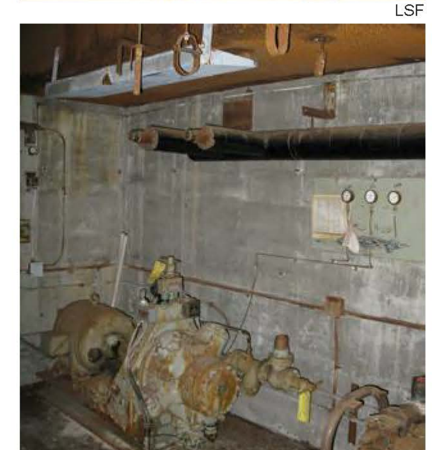
A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

LSF

LSF

LSF

LSF



LSF

BUILDING LEXINGTON FIELD HOUSE

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	Yellow	Yellow	Yellow		
2 MOD					
3 MOD					
CAVES & COMMONS	Yellow	Red	Yellow		
LABORATORY					
ANECHOIC CHAMBER	Red	Red	Red		
ANTENNA ENCL/CONTROL	Red	Red	Red		
ASSEMBLY/PREP	Red	Red	Red		
BIOLOGICAL	Red	Red	Red		
CLEAN ROOM	Red	Red	Red		
COMPUTER LAB					
ELECTRONICS SYSTEMS	Red	Red	Red		
EPITAXIAL					
HANGAR					
HIGH BAY	Red	Red	Red		
LASER					
MATERIALS LAB	Red	Red	Red		
MICRO ELECTRONICS					
OPTICS	Red	Red	Red		
PROCESS SUPPORT	Red	Red	Red		
WET CHEM/MATL PREP	Red	Red	Red		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	Yellow	Red	Yellow		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	Yellow	Yellow	Yellow		
EQUIP TEST/REPAIR	Red	Red	Red		
FILES/STORAGE	Red	Yellow	Yellow		
FOOD SERVICE/VENDING	Yellow	Yellow	Yellow		
FSD SUPPORT	Red	Yellow	Yellow		
GRAPHICS & PUBLICATIONS	Red	Yellow	Yellow		
LIBRARY/ARCHIVES	Red	Yellow	Yellow		
MACHINE SHOP	Red	Red	Red		
OFFICE SUPPORT	Yellow	Yellow	Yellow		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	Yellow	Yellow	Yellow		
STOCK ROOM	Yellow	Yellow	Yellow		
TELE/DATA SUPPORT	Yellow	Yellow	Yellow		
TOOL ROOM	Yellow	Yellow	Yellow		
TRAINING	Yellow	Yellow	Yellow		
WORKSTATION AREA	Yellow	Yellow	Yellow		
BUILDING SUPPORT					
PRIMARY CIRCULATION	Yellow	Yellow	Yellow		
BUILDING SYSTEM	Yellow	Yellow	Red		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

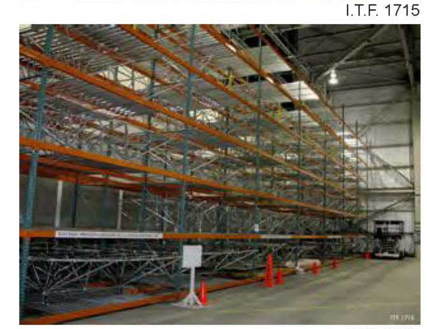
Green	EXCELLENT COMPATIBILITY/ COMPLIANCE
Yellow	AVERAGE COMPATIBILITY/ COMPLIANCE
Red	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS


1715 Boeing 707


1715 Pylon C


I.T.F. 1715


I.T.F. 1715


I.T.F. 1715

BUILDING 1715

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟢	🟢	🟢		
LABORATORY					
ANECHOIC CHAMBER	🟢	🟢	🟢		
ANTENNA ENCL/CONTROL	🟢	🟢	🟢		
ASSEMBLY/PREP	🟢	🟢	🟢		
BIOLOGICAL	🟢	🟢	🟢		
CLEAN ROOM	🟢	🟢	🟢		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟡	🟢	🟢		
EPITAXIAL					
HANGAR					
HIGH BAY	🟢	🟢	🟢		
LASER					
MATERIALS LAB	🟢	🟢	🟢		
MICRO ELECTRONICS					
OPTICS	🟡	🟢	🟢		
PROCESS SUPPORT	🟢	🟢	🟢		
WET CHEM/MATL PREP	🟡	🟢	🟢		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟡	🟢	🟢		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟢	🟢	🟢		
FSD SUPPORT	🟢	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟢	🟢	🟢		
LIBRARY/ARCHIVES	🟢	🟢	🟢		
MACHINE SHOP	🟢	🟢	🟢		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟢	🟢	🟢		
STOCK ROOM	🟢	🟢	🟢		
TELE/DATA SUPPORT	🟢	🟢	🟢		
TOOL ROOM	🟢	🟢	🟢		
TRAINING	🟢	🟢	🟢		
WORKSTATION AREA	🟢	🟢	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟢	🟢	🟢		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE

A EXISTING BUILDINGS FUNCTIONAL ANALYSIS

BUILDING 1718

	BAY SIZE	ZONE DEPTH	FL.-TO-FL.	LOAD CAPACITY	VIBRATION
OFFICE					
SINGLE	🟢	🟢	🟢		
2 MOD					
3 MOD					
CAVES & COMMONS	🟢	🟢	🟢		
LABORATORY					
ANECHOIC CHAMBER	🟢	🟢	🟢		
ANTENNA ENCL/CONTROL	🟢	🟢	🟢		
ASSEMBLY/PREP	🟢	🟢	🟢		
BIOLOGICAL	🟢	🟢	🟢		
CLEAN ROOM	🟢	🟢	🟢		
COMPUTER LAB					
ELECTRONICS SYSTEMS	🟢	🟢	🟢		
EPITAXIAL					
HANGAR					
HIGH BAY	🟢	🟢	🟢		
LASER					
MATERIALS LAB	🟢	🟢	🟢		
MICRO ELECTRONICS					
OPTICS	🟢	🟢	🟢		
PROCESS SUPPORT	🟢	🟢	🟢		
WET CHEM/MATL PREP	🟢	🟢	🟢		
SPECIAL PURPOSE					
CLOSET					
CONFERENCE	🟢	🟢	🟢		
CONFERENCE SUPPORT					
DOCUMENT DIST/CONTL					
DOCUMENT/MAIL DIST	🟢	🟢	🟢		
EQUIP TEST/REPAIR	🟢	🟢	🟢		
FILES/STORAGE	🟢	🟢	🟢		
FOOD SERVICE/VENDING	🟢	🟢	🟢		
FSD SUPPORT	🟢	🟢	🟢		
GRAPHICS & PUBLICATIONS	🟢	🟢	🟢		
LIBRARY/ARCHIVES	🟢	🟢	🟢		
MACHINE SHOP	🟢	🟢	🟢		
OFFICE SUPPORT	🟢	🟢	🟢		
REPRODUCTION/PLOTS					
SECURITY SUPPORT					
SHIPPING/RECEIVING	🟢	🟢	🟢		
STOCK ROOM	🟢	🟢	🟢		
TELE/DATA SUPPORT	🟢	🟢	🟢		
TOOL ROOM	🟢	🟢	🟢		
TRAINING	🟢	🟢	🟢		
WORKSTATION AREA	🟢	🟢	🟢		
BUILDING SUPPORT					
PRIMARY CIRCULATION	🟢	🟢	🟢		
BUILDING SYSTEM	🟢	🟢	🟢		
UNDEFINED					
REST ROOM					
STAIR					
GENERAL UTILITY					
VERTICAL SHAFT					

🟢	EXCELLENT COMPATIBILITY/ COMPLIANCE
🟡	AVERAGE COMPATIBILITY/ COMPLIANCE
🔴	POOR COMPATIBILITY/ COMPLIANCE